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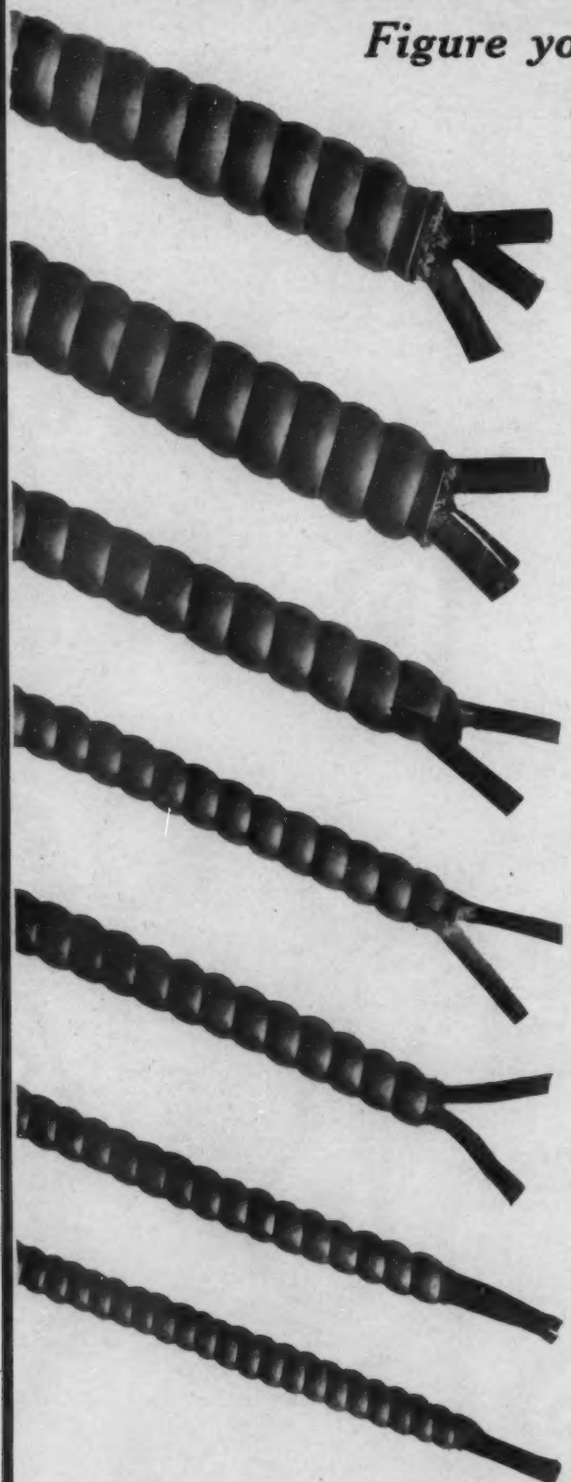

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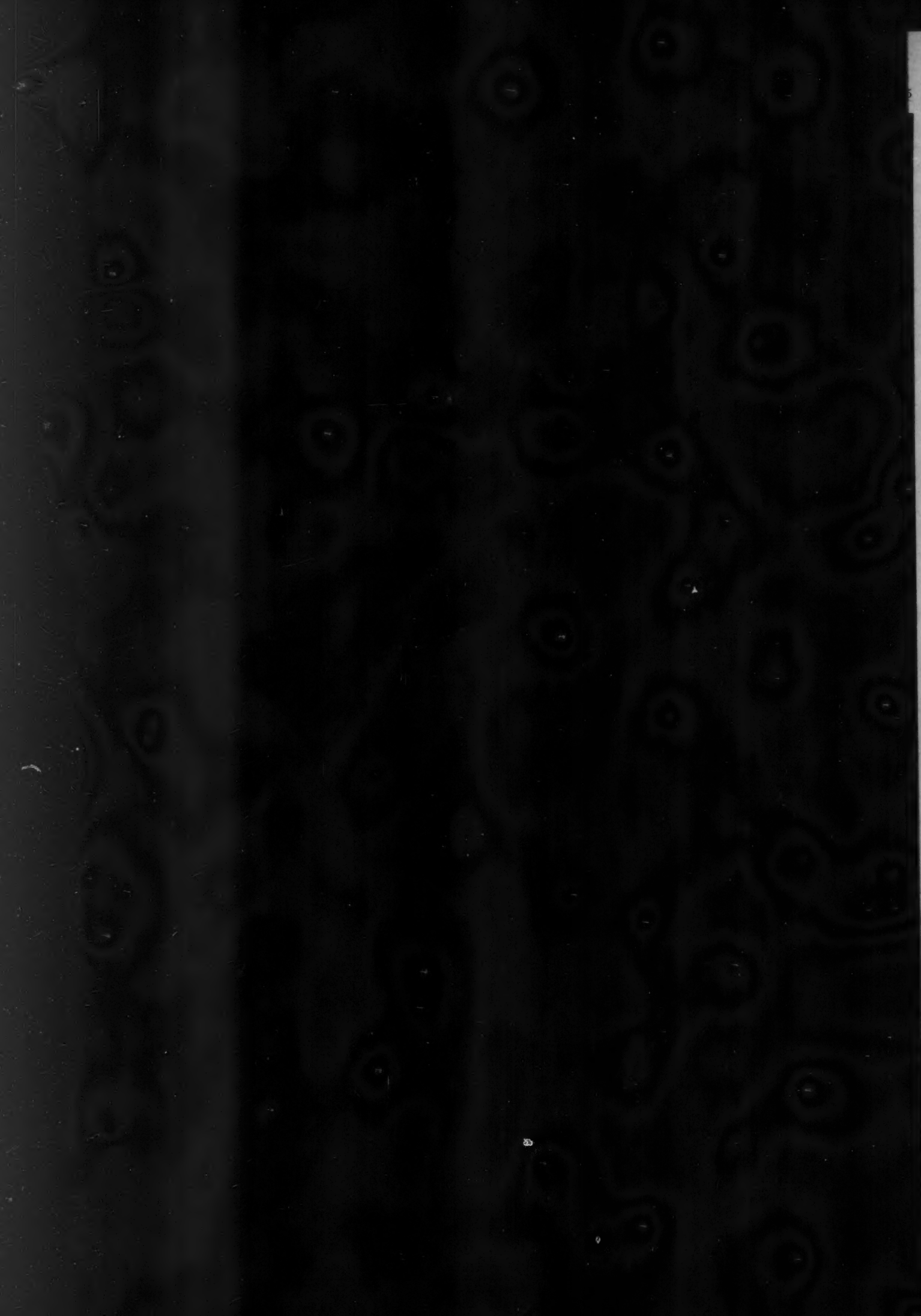

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ELECTRICAL HYDRAULIC MINING

BY N. K. COOPER.

(This is a description of a successful method of gold mining hydraulically which is applicable to those places where the gravels are too shallow to permit satisfactory dredge operations. Costs of installation and operation are given.—The Editors.)

The experience of the early hydraulic miners in California paved the way for the development of hydroelectric power. Today that power is in turn making hydraulic mining possible in many cases where water is scarce, or the head not great enough for economical operation. Many of the gold-bearing gravels of California also cannot be profitably dredged because they are so shallow or the bedrock is so uneven as to make dredge operation unsatisfactory, if not impossible.

These difficulties have recently been solved by a unique installation near Loomis, California, where The Associated Miners are now working about sixty acres of level gravel, averaging twelve feet in depth.

The system centers about a 400 h.p. motor driven pump, which performs the double duty of supplying water under 250 ft. head for a giant, which washes down the gravel, and also to a hydraulic elevator, which raises the gravel to sluice boxes. This pump is a 12 in. horizontal 2-stage series Byron Jackson centrifugal, driven at 1160 r.p.m. by a 400 h.p. 2200-volt Westinghouse motor, to which it is directly connected. The pump handles 4500 gal. of water per minute under the 250 ft. head.

Comprehensive View of Hydraulic Giant in Operation, showing Hydraulic Elevator and Head of Sluices.

In starting operations a pit was first dug for the elevator, and a line of 15 in. pipe run to the elevator and lines of 14 in. pipe to two giants placed around the elevator. While only one giant is operated most of the time this arrangement enables the bedrock to be washed, even in deep crevices, and to be cleaned

up by the streams from the giants with but little hand work. Each of these giants has a 2½ in. nozzle, and is of standard California construction.

The hydraulic elevator lifts the gravel a vertical height of 33 ft., and discharges it into a long line of elevated sluices, where the gold is caught in riffles and undercurrents and whence the water runs into a settling basin. The elevator has a 9 in. throat and 3½ in. nozzle, and handles from 150 to 200 cu. yd. of

The Operator's Point of View.

dirt per hour. The sluices are 500 ft. long and have a drop of 7 ft. in 12 ft., from head to tail. Water for operation, 400 miners' inches, is originally obtained from a small reservoir constructed by damming the ravine, and after operation has been started most of the water is obtained from a settling basin into which the material is dumped at the end of the sluices. The water from the settling basin is thinned at the pump by means of a small stream continually running from the reservoir, the proportion being about one part of fresh water to four parts of settled water.

Electric power is obtained from the Great Western Power Company, who installed two 250 k.v.a. transformers, which step the current down to 2200 volts. Power is supplied at the minimum rate of $400 per month, with the right to cease operations during July, August and September in case water fails. With the plant operating continuously day and night the maximum cost of current is $1700 monthly.

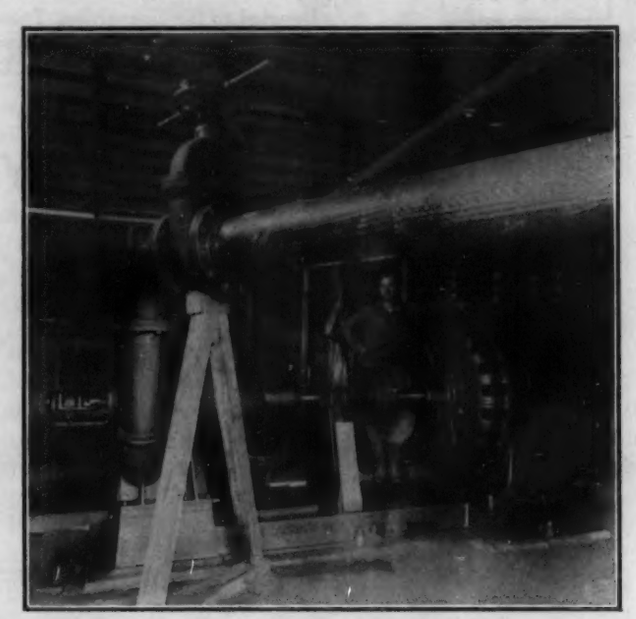
In operating the system six men are necessary during the day and four when operating at night, the extra two men during the day doing such odd jobs as keeping the banks of the settling pond in repair and cutting down trees ahead of the giant.

Following is an itemized statement of costs of installation:

Cost of Hydraulic Gold Mining System.

Centrifugal pump, f.o.b. Berkeley	$1,770.00
400 h.p. motor, f.o.b. San Francisco	1,897.00
Freight	50.00
Hydraulic Elevator, (special price)	500.00
Two giants	237.00
Sluices	250.00
Tools	200.00
Camp Buildings	1,000.00
Labor	1,000.00
Incidentals	500.00
Pipe	1,400.00
Total	$8,804.00

The experience of this plant has been so satisfactory that several others are now in contemplation, ranging in size from 400 to 1000 h.p. of installed capacity. As there are many similar gravel deposits throughout the state, which cannot be profitably mined under the old conditions, this unique method should be of considerable value in working them. Credit for originating and developing the idea is due to Mr. Samuel C. Laird, of Loomis, and Mr. S. D. Woods, of



Interior View of Pump House.

San Francisco, the latter having backed the plan financially.

Results show that the power consumption is about half that of the average dredge handling the same amount of material, but as it can be used where a dredge cannot be operated, it certainly offers an excellent load for the power company.

The Diesel four-stroke cycle is that under which most Diesel engines operate. During the "admission" stroke, the piston travels downward and the cylinder is filled with air only. During the "compression" stroke the piston travels upward and this air is compressed to 500 lb. per sq. in. and its temperature is thus raised to about 1000 degrees F., which is hot enough to ignite any liquid fuel injected into it. Just before the piston reaches the upper end of the compression stroke the fuel valve opens and a measured quantity of fuel oil is gradually sprayed into the cylinder until the downward "power" stroke is about one-tenth completed, as a result of its expansion. Finally during the "exhaust" stroke the piston travels upward and the products of combustion expelled from the cylinder through the exhaust valve, thus completing the cycle. The quantity of oil delivered to the spray is adjusted so that the pressure does not rise above the compression pressure during the "power" stroke, this amount being regulated according to variations in load by the action of the governor on the fuel pump. It is usually injected at about 750 lb. pressure by cool air from a compressor driven from the engine shaft.

EFFECT OF FORESTS ON RUN-OFF.

BY J. C. STEVENS.

(Continued.)

When spring comes the melting first begins in the open during the days, with freezing at night; while in the forest practically no melting occurs. As warm weather advances the snow on the exposed portions in the open is gradually melted and the drifts begin to supply some water, but no floods can ever be caused from slow melting of deep snow drifts. The snow drift, especially in the higher altitudes, is an important conserver of precipitation. It continues to supply water to the streams long after the even blanket of snow in the forest has entirely disappeared.

The advance of spring under forest cover has an entirely different effect. The snow gradually compacts, the volume becomes less but without reducing the surface exposed. When warm weather really comes and the temperatures during both day and night are above the freezing point, the even blanket goes off with a rush, frequently causing higher water than if the same volume had been deposited in the open. True, the maximum rate of run-off from the forest occurs later than if the area was open country, but the value of this maximum is generally greater. This delay might be useful if it extended the melting period well into the summer, but the delay is only a matter of a few days at most and after it is past the flow diminishes much more rapidly than after the maximum from the melting of snow drifts in the open.

Do Forests Diminish Floods?

This feature of the forest question has been touched upon in what has preceded, but the belief is so general that forests have an enormous influence in reducing the height of floods that the subject deserves special mention.

It may be true that the forest cover has a moderating effect on medium stages of a stream, but even this has not been demonstrated beyond question. Certain it is that great floods in rivers are not diminished in the slightest by forests on their headwaters. Great floods are always caused by excessive rainfall, frequently attended by sudden melting of snows. On the Pacific Coast the "Chinook" wind is the most frequent cause of heavy floods. This has its counterpart in the "foehn" of Switzerland. There, dry, warm winds have been known to melt as much as three feet of snow in fifteen hours. Under such an influence the even blanket of snow in the forest is particularly susceptible to quick melting and gives rise to greater floods than the same volume of snow would from its usually drifted positions in the open country.

It requires a relatively small quantity of water to sufficiently saturate the litter in a forest floor to permit rapid run-off. It is not necessary that this forest litter become completely saturated before run-off occurs. Mention has been made of the "thatch" that leaves sometimes form over the surface of a forest floor. This is particularly effective in deciduous timber after the spring snows have been melted. In our western forests I have seen large areas in the spring completely covered, almost as effectively as if shingled—by the leaves of maple, alder and other deciduous trees and brush. To a less degree the needles of conifers also may prevent complete saturation of the forest litter and humus before rapid run-off begins. But even if it be admitted that complete saturation must occur before water begins to run off, the amount of water so required is too slight to appreciably diminish the height of floods. It can only diminish the moderate freshets. These freshets are not the controlling feature in design of structures either for river improvement or the utilization of water supplies. It it always the maximum that governs.

On large rivers serious floods are produced by combinations of flood waters from tributaries arriving simultaneously. Such combinations result from the peculiar distribution of rains over the area and are beyond human control. In many cases retardation of the flood from a forested portion may cause a more disastrous combination than if that particular contribution had not been retarded. However, no general conclusions can be drawn from these circumstances, each area and each flood on it being a law unto itself.

If forests mitigate floods, they can only accomplish the result either by storing a considerable portion of the precipitation or by mechanically retarding the run-off to produce a beneficial combination. A uniform retardation over the whole area will not lessen the maximum run-off, it only delays the time of its occurrence, while a non-uniform retardation, as we have just seen, is just as likely to be harmful as beneficial. We have also seen that the storage capacity of a forest is very limited. In countries of heavy rainfall this storage, in so far as it does exist, is beneficial, but in countries where the total water supply is required, it is a positive detriment since this amount is not returned to the stream but is permanently removed from the water supply of the region.

Do Forests Increase Low Water Flow?

In view of the fact that the forest is a heavy consumer of water, and that the ground water level under a forest cover is substantially lower than in the open country, there is positively no evidence upon which to base an affirmative answer. During the summer months stream flow can only be maintained by drawing on water previously stored in snow banks and in the ground, or by the run-off from summer showers. In the open country snow drifts continue to supply water to the stream long after the snow has disappeared from the forest.

The light summer shower certainly adds little to run-off from a forested region, for it is usually absorbed completely by the crowns and forest litter. But in the open country the same shower may produce considerable run-off or add something to percolating water.

Since the water stored in the humus is not returned to the stream, but is evaporated, the only thing left to increase run-off is the increment to ground water induced by a forest cover, and we have seen that this is small in any event and is just as likely to be a decrement. The conditions in summer in a forest are these: moist litter and top soil, dry stratum where tree roots penetrate, moist soil, and ground water below. In the open country the conditions are: dry top soil, then moist soil merging into ground water. Of the two conditions, the open country will probably furnish the greater amount of percolating water, other things being equal. The differ-

ence, however, is seldom great enough to be of economic importance one way or the other.

Summary.

I will briefly sum up the pertinent points relating to the general influences of forests on climate, precipitation and run-off.

In spite of the general belief that forests have a great mitigating effect on floods, induce great lower water, and favorably influence the climate of a region, it is seen that a rigid analysis of the process by which this influence is said to be exercised leaves serious doubts as to the efficacy of forests to fulfill these claims. We have found that:

1. Forest litter and humus do not necessarily induce greater percolation of water into the underlying soil than would obtain in the open, and wherever it does have this effect the increment to ground water is offset by the excessive use of water by transpiration and for the growth of trees. In porous soils, a forest cover may effectively prevent percolation.

2. Forests may absorb and dissipate intermittent showers without permitting any run-off or percolation. In the open, however, such showers always produce some run-off or add something to ground water.

3. Ground water level in forested lands is lower than in the open, owing to excessive use of water for plant growth. This reduces the water available for stream flow during the summer (growing season) and instead of adding to the low stages of streams, the forest in reality deprives the streams of the water so consumed.

4. Forests prevent the formation of snow drifts, which is recognized as an important storage agency for keeping up the summer flow of streams. The melting of the uniform blanket of snow under a forest cover is somewhat delayed in time, but may induce higher floods than could possibly come from melting in the open.

5. Floods are not reduced by forests. Once saturated, the forest has no further ability to retain water, and the run-off proceeds as completely as in the open. The amount required for saturation is small and can only affect the medium freshets to a small degree.

6. The amount stored after each rain in the humus is not returned directly to the stream, and but rarely given up to the soil. It is virtually lost by slow evaporation and the transpiration from smaller plants on the forest floor.

7. The net effect of these influences is that the total run-off from a forested area is less than that from an open area, other things being equal, and that the uniformity of stream flow is not improved.

8. Forests do not increase precipitation. The influences they exert through increased evaporation, decreased temperature or convection currents are altogether impotent to accomplish this result. Precipitation is caused by forces of much greater magnitude.

Soil Erosion.

There is a widespread belief that forests are necessary for the prevention of soil erosion. But with this, as with the other features connected with the forestry propaganda, there is a wide difference between the actual benefits secured and those popularly attributed to the forests.

Only in a few special cases has it been proven that the mere cutting down of trees resulted in harmful erosion of the land. Wherever forests have existed in the past, some growth is sure to follow the removal of them. Such a growth is generally of different varieties, but its efficacy in preventing soil erosion is no less. All things considered, small underbrush and the tangled mass of ferns, vines, grasses and the other small growth that inevitably follows logging operations or fire, are even more effective in preventing soil wash than the virgin timber.

In a few cases where soil is scanty, slopes steep, and rainfall abundant and intense, the delicate balance between permanency of soil and the tendency to wash is disturbed by the removal of trees, and erosion follows. Such instances, however, are specifically local, affect comparatively small areas, and it is not just to draw general conclusions from them.

It is only on sloping ground that there is any tendency to erode, in any event, and any kind of growth tends to prevent it. Experience has shown that grasses are more effective in preventing erosion by water than any other single agency. On the other hand, erosion by wind is more effectively prevented by large timber, while a dense cover of small brush, chaparral, etc., will prevent the combined effect of wind and water erosion better than either.

Erosion of soil by water results from the cultivation of lands, the building of roads, trails, logging chutes, etc., etc., and not from the mere removal of timber. This statement is worthy of emphasis. Erosion almost invariably results from some development process that man has initiated. I have seen deep gullies in a grass covered field that began by water running in the wheel tracks left by one wagon driven over the surface. Elsewhere in the field the grasses effectively prevented soil wash. We can, therefore, only hope to prevent soil erosion in so far as we can dispense with these development processes.

Soil erosion has been an element in determining the topography of the country since time began, and will continue to be an important factor. All valley lands have been formed from soil washed from the adjacent hills. Rocks on the hills disintegrate and are gradually washed by rain and carried by the streams to lower elevation. Thus all agricultural lands have been formed. Where one part of the country is the loser, another portion gains by this process. We cannot prevent it and ought not if we could. There is not the slightest evidence that the annual burden of silt and soil carried by the rivers of the country has appreciably increased since man's occupancy of it.

Forests are cut for some specific purpose. If for the timber only, a new growth soon springs up even in the abandoned roads and trails and in a few years heals all the scars man has made. If the area has been severely burned, this growth is delayed, but it will eventually follow and the erosion which has increased during the time of recovery will gradually decrease until a balance is once more established. If the area is cleared for agricultural purposes, erosion may continue to the detriment of the

owner, but someone else further down the stream is the gainer. We cannot dispense with agricultural lands, and the solution of the problem rarely lies in reforesting the area but in adapting agricultural methods to meet the conditions. The change from forest to meadow lands and pasture never increases erosion, and it is possible to so plow lands on fairly steep slopes that excessive erosion will not follow.

We hear a great deal about the rocks and debris from deforested hills filling the river channels and covering the rich valley lands. The careful observer will find the same thing is true where virgin forests exist, and in addition we have the river channels filled with drift, uprooted trees, and timber debris of all kinds. Excessive flood heights in wooded countries are frequently caused by drift jams in the river channels, new channels are cut and valley lands flooded. Damages from such causes are not insignificant, and menace habitations contiguous to virgin forests as surely as those adjacent to cut-over lands.

In this matter our ills are purely relative. We cannot dispense with agricultural lands, and we cannot dispense with works of development and improvement; neither can we prevent soil erosion. Certain local conditions may be improved by local treatment. In many instances unnecessary damage has been done, but we must not draw the general conclusion from such isolated cases that the removal of forests is always a menace to the welfare of the country.

A Study of Existing Data on Forest Influences.

If the conventional forestry theory is correct, we should be able to detect the influences claimed for them in records of run-off from areas where material changes have taken place in the forest cover of the drainage area, during the periods of record. Such an analysis should deal with simultaneous records of precipitation and run-off covering a long period of years both before and after the change in forestry cover occurred. As before stated there is no fixed relation between run-off and precipitation, even on the same watershed. Each year precipitation is different in amount, distribution and intensity, and the run-off necessarily exhibits the same general fluctuations. These quantities, however, only fluctuate between certain limits, hence if the records are accurate and of sufficient length, the average for both conditions of forest cover should exhibit the changes, if any, for which the forest is responsible.

The unfortunate thing is that existing records are not of sufficient accuracy nor of sufficient length and completeness to warrant an exhaustive analysis to determine the actual influence of forests. We can not, therefore, expect to show the actual influences of a forest cover, but we can show the limit beyond which this influence does not extend, which is of no small importance. It will be found that this limit is infinitely small compared with the popular belief in its magnitude, that is to say, the actual influence of a forest in modifying run-off is too small to be detected in any existing records, while it is generally believed to be of the first magnitude and importance. The data used for this study are of the same quality as to accuracy and completeness as are those on which are based the expenditures of large sums in development works for the utilization of water supplies, and they are sufficiently accurate for those purposes.. If, then, an influence is so obscure that it cannot be detected by the same process by which we secure the data on which are based the developments of water supplies, can this influence be of economic importance?

(To be continued.)

CENSUS FIGURES ON ELECTRIC LIGHT AND POWER.

Preliminary figures of the forthcoming quinquennial report on the central electric light and power stations of the state of Nevada have been given out by Director W. J. Harris, of the Bureau of the Census, Department of Commerce. They were prepared under the supervision of W. M. Steuart, chief statistician for manufactures.

The statistics relate to the years ending December 31, for 1912 and 1907, and June 30 for 1902, and cover both commercial and municipal electric plants. They do not include electric plants operated by mining companies, factories, hotels, etc., which consume the current generated, those operated by the Federal government and state institutions, or plants that were idle or in course of construction.

The figures as presented for Nevada show that during the decade 1902-1912 there were substantial gains in the industry. In the estimated number of arc lamps wired for service, 321 there was an increase of 312 per cent, while the increase of all other varieties was 37,230, or 453 per cent. In the case of the aggregate income of the eight establishments reported in 1912 there was a gain of $574,393 over 1902. There were also large gains (797 per cent) in total horsepower reported, the output of stations in kilowatt hours, and in the number of stationary motors served and their horsepower capacity.

The number of persons employed in 1912 was 147, an increase of 129, or 717 per cent, over 1902.

The figures in detail are shown in the accompanying table:

Nevada.	1912.	1907.	1902.	Per cent of Increase: 1902-1912.
Number of establishments	8	9	5	60.0
Commercial	7	9	5	40.0
Municipal	1	..	..	....
Income	$618,942	$372,108	$44,549	....
Light, heat and power	$607,597	$352,959	$44,549	....
All other sources	$11,345	$19,149	.....	....
Total expenses, including salaries and wages	$428,255	$245,291	$39,687	979.1
Total number of persons employed	147	78	18	716.7
Total horsepower	15,420	6,980	1,720	769.5
Steam and gas engines (including turbines):				
Number	14	9	4	250.0
Horsepower	2,880	695	250	.....
Water wheels:				
Number	13	9	4	225.0
Horsepower	12,250	6,260	1,470	753.1
Auxiliary engines:				
Number	(1)	1	.....	.....
Horsepower	(1)	25	.....	.....
Kw. capacity of dynamos	10,513	5,690	764	.....
Output of stations, kw.-hr.	44,969,772	29,621,730	1,508,910	.....
Estimated number of lamps wired for service:				
Arc	321	[2] 327	78	311.5
All other varieties	45,443	[2] 63,939	8,213	453.3
Stationary motors served:				
Number	303	411	13	.....
Horsepower capacity	12,384	6,850	180	.....

[1] Not reported separately.

[2] Exclusive of 1 arc and 692 lamps of other varieties reported by the electric companies as used to light their own properties. Lamps used for such service were included in the number reported for 1912.

LIGHTING METHODS

SCHOOL ROOM LIGHTING.

BY ROMAINE W. MYERS.

(The necessity for good school room lighting and its arrangements are first mentioned and a properly designed installation then described in detail. Mr. Myers is a consulting and illuminating engineer, Oakland, Cal.—The Editors.)

Public school houses of our large Western cities are quite often used for evening classes, so that the question of proper lighting is of considerable consequence. The importance of good illumination in rooms where students are working, cannot be overestimated.

We have read a great deal in the past few years regarding the conservation of natural resources, but how about the conservation of this greatest of nature's

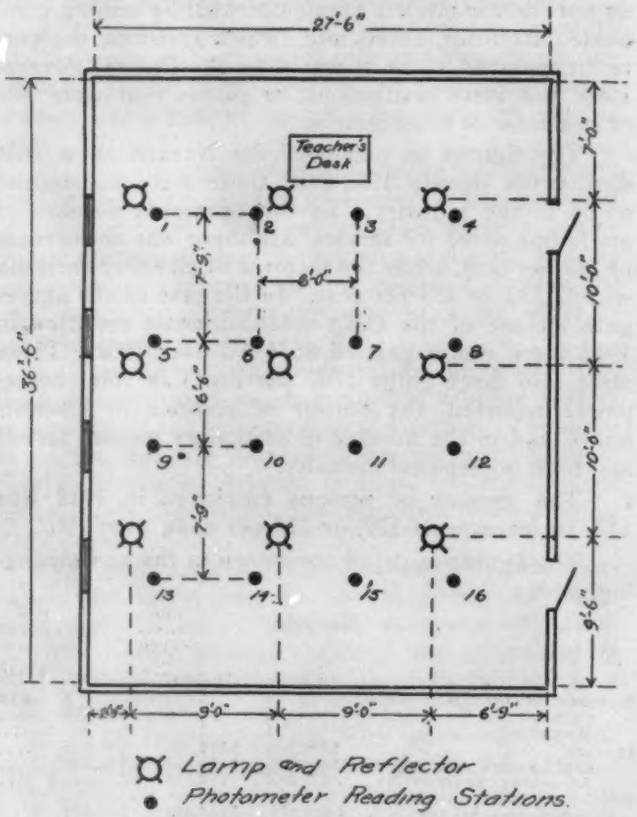


Fig. 1. Floor Plan of School Room and Location of Test Stations.

resources—the eye of the child? This should receive more attention, in fact, if this were so, the doctors employed to investigate the health of school children would have their labors considerably lessened.

Improper or insufficient lighting produces a disturbance of the balance of the retina, affecting the nervous system thereby also causing headaches, etc. The danger that children are subjected to when the equipment violates every requirement of proper lighting is evident, and the possible loss to the nation equally obvious.

It is a serious enough handicap for children to have to attend night school to obtain an education. The fact that by doing so they are subjecting themselves to an obstacle so serious as to impair their eyesight should be remedied. Poor lighting has more to do with intermittent or non-attendance at night schools than any other cause. Good lighting methods will ensure better health and better results from the students' efforts.

Until recently architects, school boards and teachers have been perhaps pardonably, but nevertheless, sinfully lax in providing the best lighting possible for the rising generation. This is because they have been either absolutely indifferent or ignorant of the physiological requirements of artificial lighting. It is time that all should realize that the eyes of the children in their charge, are of more importance than the decorative features or artistic effect of the lighting fixtures in the school room.

An example of good lighting installed in two rooms of the Oakland High School, Oakland, Cal., is shown in Fig. 1. This is installed at a minimum of expense and consists of placing the outlets unsymmetrically with reference to the rows of desks, so that the shadows on the pupil's desk will fall from left to right. Nine outlets are shown, each being equipped with No. 247 Asymetrical Holophane reflectors, with 100 watt bowl frosted lamps.

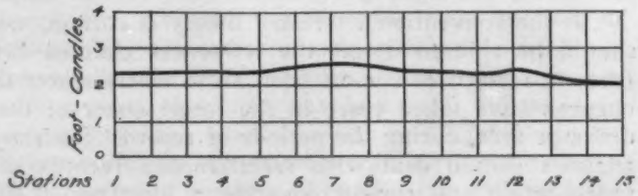


Fig. 2. Uniformity of Illumination on Desks.

Horizontal readings in foot-candles were taken on desks at points shown in Fig. 1 with a photometer, the readings of stations being as follows:

Illumination Readings.

Stations.	Foot-candles.	Stations.	Foot-candles.
1	2.3	9	2.35
2	2.3	10	2.35
3	2.3	11	2.3
4	2.3	12	2.4
5	2.35	13	2.15
6	2.5	14	2.10
7	2.6	15	2.0
8	2.5	16	2.1

With the test stations located as shown, there was obtained a value of 2.3 foot-candles as the average.

Fig. 2 shows graphically the uniformity of the illumination produced.

The height of room is 10 ft. 0 in., the center of lamps being 9 ft. 6 in. from the floor. The ceiling is of comparatively light color with the customary blackboards on the walls. These blackboards are also very satisfactorily illuminated, specular reflection being entirely absent.

The reflector used extends down, covering the lamp so that it is not in the line of vision, thus eliminating glare and providing good diffusion, which with proper direction means good lighting.

METHOD IN HOME LIGHTING.

(Continued.)

4. Entrance Hall.

To greet guests amid the depressing influence of dim lighting or under a glaringly brilliant white light is not desirable. The ladies, especially on arrival, desire to appear at their best, and this is not possible with either of these extremes or under a direct light casting heavy shadows. The end desired is accomplished by the installation of a so-called, warm tone of light, properly diffused.

It can be secured in a variety of ways, and by the use of all three fundamental systems of lighting.

It is thought by some that just sufficient light in the entrance hall to permit the removal and disposal of wraps is all that is needful and very low intensities have been recommended.

This does not, however, agree with good practice in the West. Rather it is an outgrowth of those days in which it was necessary to leave the gas burning so as to save the trouble—a real trouble too—of lighting the jet whenever a summons to the door had to be answered. In those days, the blackened ceilings and walls—more so here from the draught blown gas jet than in any other part of the house—were not inviting, and the main object was not so much to illuminate as to conceal these defects.

With the porch or veranda light burning continuously and the greater ease in switching electric lights on and off, it is not necessary to leave that burning in the hall, and it is used for so short a time, that economy in the size of lamp is not essential.

The "opal" ball is popular for this lighting but more pleasing and more ornate effects can be obtained by the use of indirect and semi-indirect systems.

A large variety of wrought iron and pendant fixtures can also be advantageously used provided the glassware is carefully selected as to warm color of transmitted light and good diffusing power.

Pompeian lamp designs and adaptations of these are also both popular and pleasing. Cairo or Arabian lamps, Turkish and other Oriental lantern effects can also be properly used, the silk draperies being very pretty.

In the entrance hall are the switches for the porch or veranda lights, the garage and outside lighting and the hallway light. These should be all, three-way.

5. Living Room.

The dark furniture and furnishings usually installed in the living room absorb the light.

It is a well-known fact that white light is composed of all the colors of the spectrum, but it is not so generally understood that no objects have any inherent color of their own, but reflect a hue which is the sum of all the colors of the spectrum other than those absorbed by them.

To illuminate means to decorate. An illuminated object is literally painted with light.

This "painting" process is most expensive when the light falls upon dark objects for it can then illuminate them only to a very low intensity. Light reflected from the walls of a room also contributes to the better illumination of other objects, but if all the light impinging on the walls is lost, or absorbed, on account of dark wall paper, then additional light must be provided. Dark objects thus prove a perpetual expense.

For the so-called "warm" appearance of a room, dark furnishings are not an essential.

In the living room it is more economical to install a system which will provide a low intensity of general illumination and greater localized intensities wherever desired. This would necessitate at least one good reading lamp. For the piano, a special lamp would also be required.

It too often happens that these lamps are selected only because of their artistic or pleasing appearance. Utility—their fitness for the practical purpose for which they were designed, is of even greater importance.

Good diffusion of the light over the surface illuminated should be the prime consideration. This may be secured, though inefficiently, by using totally frosted lamps. There are, however, many practical portable lamps now on the market. They should not have too great a surface brilliancy, that is, they should not transmit too great an amount of light and should reflect the light diffusely in a useful direction. If the lamp reflects specularly or too great an amount of light comes direct from the bare lamp, very noticeable striations—streaks of bright light—appear on the surface illuminated. This is not only objectionable in appearance, but causes the eye to rapidly tire.

Where no provision has been made for the use of portable lamps, outlet boxes for this purpose may be readily and usually inexpensively installed with positively no damage to existing decorations.

If a system of general illumination only is desired and dark wall decorations also selected, it is advisable both on account of ocular comfort and relative economy to install an indirect system.

Glare, which causes considerable eye-strain and irritation is a condition resulting not only from the us of bare lamps, but occurs also when there is a great contrast between a luminous lighting unit and the ground against which it is viewed.

The influence upon the cost of light where dark decorations are used has been mentioned.

Between indirect lighting installed in a room with light walls as compared with dark, it is about twenty per cent, whereas with direct lighting and the use of comparatively efficient lighting glassware the difference approximates fifty per cent.

On account of the better quality and distribution of the illumination under these conditions, indirect lighting may be considered more efficient, although it would take practically the same quantity of light with these two systems to produce the same illumination intensities.

Semi-indirect lighting would not be as efficient as either and if decorative or art glass shades were to be used the efficiency would be extremely low and satisfactory lighting practically impossible.

Where indirect lighting is installed the ceiling should not be a flat white but delicately tinted to harmonize with the other decorations.

[To be continued.]

PUBLIC UTILITY COMMISSIONS AND PUBLIC SERVICE CORPORATIONS.

BY W. D. SCOTT.

(This paper which is a review of the better business relationship between public utilities and their customers resulting from commission control, was presented by Mr. Scott at a recent joint meeting of the Portland Section A. I. E. E. and N. E. L. A.—The Editors.)

The public service business as a whole can be considered a comparatively recent development. Until within the last few years the executives and stockholders of public service corporations regarded inquiries concerning their business by individuals or government authorities an infringement of their personal or charter rights. This spirit, when evinced by individuals or smaller corporations, could not, in itself, be regarded as harmful to the general public. In a measure, no doubt, the attitude of the larger public service corporations was an outgrowth of the sentiment of the individual which dislikes public criticism of private matters, which feels that his business, is his business, and if through accommodating a greater number of patrons his business nets him a better rate of return, then, the methods which he uses are his methods and are not subject to regulation by others.

With the increased volume of business under one control which follows the consolidation of small industries into larger ones, and the fact that a great many of the so-called public service corporations of today are of necessity in the nature of a monopoly, considerable injustice might result to a large number of people should the judgment or sentiment of these corporations not be based on a broad minded and liberal policy.

The very fact that the complexity of the business does not permit of all of the customers being taken into the confidence of the corporation, and does not permit of the various operating steps of the corporation being fully and carefully explained, has resulted in many misunderstandings and much dissatisfaction.

A large corporation must of necessity deal in averages. It is particularly difficult to convince an individual customer, who has a complaint, that it is only reasonable that mistakes and errors will occur. If this customer is treated as an average case and is shown that his complaints are known, that he represents but an average unit out of the total number of units, a natural sense of dissatisfaction results. He must be treated as an individual.

Laying aside all matters of finance and questions of deliberate dishonesty, roseate promises of promoters and the sale of service for less than actual cost, the customers of public service corporations have, in many instances, come to distrust the officials and employes of corporations. This misunderstanding has often resulted through the fact that the particular employe, who met and answered the complaints of the particular customer, did not occupy a position which enabled him to have all of the facts at hand for explaining the ways and means of the company's policy.

With subdivision of authority and minute specialization it becomes difficult to educate a sufficient number of employes, whose general knowledge of their particular business is broad enough to enable them to discuss intelligently the business policy and methods of their particular company. In many instances even the men who occupied the larger executive positions were in doubt as to just why a certain charge for service was a reasonable charge or why a certain line of policy was best for all of the customers. The principal difficulty existed through their inability to present their side of the case from their customer's point of view.

When rate investigations were first started with common carriers a phrase was used in connection with the matter of establishing rates which called forth considerable adverse comment. "All the Traffic Will Bear," was the term which brought down upon a great many railroad officials very severe criticism. If, at the inception of such investigations the larger executives had been able to explain that this phrase did not mean all of the possible revenue to be extracted from any given set of customers, irrespective of its effect on the prosperity of the community in general or the common carrier in particular, a large amount of unjust criticism would never have been made.

There is none but will concede, that, in order to exist, and in order to secure the necessary capital for future extensions, any utility must receive sufficient revenue to enable it to satisfactorily carry on its business and earn a return upon its investment which will satisfy the investors who placed their money in the business and expect security and income.

If the phrase "All the Traffic would Bear," was translated to mean not greedy extortion by overcharges, but the minimum rate which would insure a reasonable return upon the investment and at the same time put the extension of the company's business to its greatest possible limit for the benefit of the whole community no such odium as now exists would be attached to it.

When some customer brings up a particular rate for a particular class of service and the public service corporation is not able to show definitely and exactly that the rate or charge is based on service costs, the customer or individual naturally begins to suspect that other statements made by any representative of any corporation are subject to investigation.

The general dissatisfaction among the customers of large corporations has brought into existence various regulating bodies. These regulating bodies investigate the condition of the corporation, both from the question of rates charged to customers and from the question of financial responsibility to investors. The customer and the investor have more confidence in a statement made by a third or disinterested party; has come to learn that rulings as handed down by the various commissions are not the matter of snap shot judgment, but are judgments rendered after due deliberation and the presentation insofar as possible, of all facts bearing on any particular case. Various regulating bodies maintain inspectors or representatives, who explain the physical operations necessary to serve the customers of any utility. Operating difficulties are explained and made clear not by a supposedly biased employe, but by someone whose position inspires confidence.

The right minded public service corporation cannot help but feel that through this representation it has the best advocate before the people that, up to the present time, has been considered. Without public confidence, no matter how hard its officials and employes may try to render adequate service, their difficulties will be constantly increased. They may render the best possible service at a reasonable charge but due to the fact that they are not able to give that personal touch to all of their business relations, which exists in small companies, they will never gain the complete good will of all their patrons.

The bright light which has been thrown on a number of corporation practices, the publicity given by investigations of public service commissions and the presentation of the real facts, has been of much assistance towards helping solve many of the unsolved problems for enterprises which are endeavoring to give a satisfactory service to the public.

It took some time at first to overcome the spirit of the individual who resented outside investigation and to establish the fact that a public utility should be managed for the public good. If the various regulating bodies may achieve but this one thing—the return of the confidence of the general public, their efforts and the expense entailed will be worth while.

The publicity given all public service matters cannot help but bring about a higher standard of business honesty and promote a spirit of fairness to all.

There has been a general awakening on the part of public service corporations that their motto can never be 'The Public Be Damned," but "The Public Be Served."

PRIVATE VS. LEASED TELEPHONE LINES.

(The following interesting item is abstracted from the Discussion on Mr. R. W. Van Norden's paper on the Lake Spauling-Drum Power Development, read before the San Francisco Section, A. I. E. E., and published in the Dec. 13, 1913, issue of this journal.—The Editors.)

A question was asked by the chairman, Mr. A. H. Griswold, relative to the statement made in the paper that there were no telephone lines carried on the transmission towers, as to how the dispatching and so forth is handled; whether by a separate line or lines already in existence, or how?

The question was replied to by Mr. Downing, who said:

"We have found the lines of the telephone companies so very much more satisfactory than lines strung on the power circuits that is was not considered necessary to go to that expense. However, speaking seriously, I might say for the information of those who do not know how we handle our dispatching, that we have a leased circuit from the telephone company running directly from our dispatchers' office in Oakland to Drum power house. In fact, it runs right from our general office here in San Francisco, to the plant. This line connects into our switching station at Cordelia, and into other important switching stations over the entire system. We may eventually put a telephone circuit on the towers. Our original plan called for such a circuit, but it has not been constructed up to this time."

THE SATURATION POINT IN ELECTRIC EARNINGS.

BY H. C. STODDARD.

(In this article the author reviews the possible business which may be secured from different classes of customers. Central stations should sell service. The saturation point will never be reached while such service can be sold to the profit of each class of consumer.—The Editors.)

Earnings from Residence Customers.

The average family can afford to pay only a very limited percentage of their income each month for lighting. Although electric lighting is continually becoming cheaper and more efficient, customers use more light, and demand a better standard or quality of illumination. In this way, the percentage remains constant.

Families having a revenue of $100 per month or less, will object to paying an average light bill of over say, $1.36 per month, but they will usually have no objection to paying 50c per month more for the use of an electric iron, partly on account of the saving of fuel and partly on account of the convenience and saving of labor to the overworked housewife.

They may frequently be induced to add additional amounts to the bill for the use of a vacuum cleaner and possibly, an electric washing machine, if supplied with these utensils on terms that do not make the first cost excessive. They will frequently use and pay for other items of electric service and convenience even if necessary to curtail some other items of expenditure.

Families having a greater income than $100 a month, especially where the amount will permit the employment of help, will often, on account of the uncertainty of this factor, be easily induced to increase the amount of their lighting bills, especially if it can be shown that certain electric home labor saving conveniences remove dependence upon this uncertain human element, which is generally inefficient also, and wasteful.

The estimated cost of fuel for cooking for a family having an income of $150 per month, is $4.68 per month. Such families should be easily induced to pay the slightly additional cost necessary to electric cooking, and might also be persuaded to use some temporary electric heating device, such as the luminous radiator.

Those customers who have an income of over $200 per month should, through wise solicitation and comprehensive educational effort on the part of the lighting company be induced to use electric service for everything. The difference in cost between electric and other means of lighting, vacuum cleaning, ironing, cooking and water heating is so small that the customer may easily be persuaded to use electric service, on account of its cleanliness, convenience, freedom from danger, smoke or gas.

The electric vehicle is also a probable source of revenue from customers having the larger incomes.

Under favorable conditions and with warmly built houses, customers having such incomes could afford to do all or part of their heating by electricity. The labor saving and cleanliness, as compared with the dirt and inconvenience of wood or coal heating will,

if properly presented, go a long way towards offsetting the difference in cost between these two methods, and in persuading the customer to adopt the electric way.

The average residence customer while willing to pay only a small sum for lighting, will gladly pay one much larger for service, and every electric service that can be supplied customers in the way of current for operating irons, vacuum cleaners, washing machines, cooking appliances, electric water heaters and electric air heaters, will result in much better satisfied customers, and bigger returns for the central station.

Earnings from Stores and Business Customers.

The average merchant will, among the items in which the charges against his gross sales are distributed, probably allow 1 per cent for heat and light, and 2 per cent for advertising.

Most merchants are easily convinced that it pays them to have their store well lighted, and it does not take much argument as a rule to convince a merchant that it is a good investment to have his windows lighted until 11 or 12 p. m. every night in the week, including Sundays and holidays. To go further than this and induce the merchant to increase his lighting appropriation, one of the best methods is to point out the advertising value of an unusually well lighted store or of some especially unique lighting feature, as of an electric sign or of outlining the front of the building in small candle power lamps.

Most merchants have a definite sum fixed, which they have decided is all that they can pay for lighting, but if they can be convinced that an electric sign or other electrical display has an advertising value, it is not difficult to get an increase in the amount for electric service.

Properly, electric window and sign lighting is chargeable to advertising, and this should be emphasized, that the percentage allowed for lighting purposes only, be not exceeded.

Very often a merchant has use for a small motor for saving labor in some part of his store, or he may need an electric heater for cashier's desk or office, and if we can sell electric service we get much more revenue than if we simply sell electric light.

Earnings from Ranch and Orchard Customers.

The rancher is sometimes the most difficult prospect to induce to use electric service, for the reason that he sells his crop and receives his year's revenue once a year while most contracts for electric service provide for monthly payments.

But nowhere else, is there such a field for the use of electric service as on the ranch. Pumping by electric power for irrigation can be made to show a large profit in increased crops and there are hundreds of other uses for an electric motor on a ranch, such as sawing wood, grinding feed, running cream separators and milking machines.

The average ranch owner works long hours and does a great deal of his work himself, partly to save expense, and partly on account of the uncertainty and unreliability of the average ranch help, and if we can convince a ranch owner that an electric motor will do certain ranch work better, quicker and cheaper than they can be done by hand labor, and save him not only the price of the labor, but the overseeing necessary to get the work done, it should be no trouble to sell him electric service.

The Saturation Point.

The saturation point of electric service will never be reached until every customer is supplied with every kind of electric service, which he can use at a profit, and afford to pay for.

Most customers are willing to more and more adopt the "electric way," and if they can be shown that an electric device will perform some service for them in a better, cheaper or more convenient manner at a price that is within their reach, they usually want it.

The customer wishes service and prefers electric service and if the customer's needs can be supplied, it is not hard to induce him to join the number of those who "Do It Electrically."

PETROLEUM AGAIN BREAKS RECORD.

The remarkably great output of petroleum during each year of this century was more than maintained in 1913. The amount produced in the past 12 months exceeded 240,000,000 barrels, or about 32,000,000 metric tons, according to estimates of David T. Day, of the United States Geological Survey. The production in 1912, which made the record up to that time, was 222,113,218 barrels. The rate of increase in 1913 was greater at the end of the year than at the beginning. California increased at least 10,000,000 barrels over 1912, almost reaching 100,000,000 barrels. The consumption in California almost equalled the production, and the addition to stocks was very slight. Oklahoma also showed a significant increase, with about 6 per cent addition to the stocks. Texas and Louisiana likewise increased their product. The output of the Gulf field declined, but this was more than offset by the increases in northern Louisiana and Texas. Wyoming showed a significant increase from the Salt Creek field. Other states generally showed a decline, which was greatest in Illinois.

The following is an estimate of the production in 1913, compared with the statistics for 1912:

Petroleum Production in 1913 (estimated) and 1912, in Barrels.

State.	1913.	1912.
California	98,000,000	86,450,767
Oklahoma	62,500,000	51,427,071
Illinois	22,000,000	28,601,308
Texas	14,000,000	11,735,057
Louisiana	12,000,000	9,263,439
West Virginia	11,000,000	12,128,962
Ohio	8,000,000	8,969,007
Pennsylvania	7,000,000	7,837,948
Wyoming	3,000,000	1,572,306
Kansas	2,000,000	1,592,796
Indiana	900,000	970,009
New York	800,000	874,128
Kentucky	500,000	484,368
Colorado	200,000	206,052
Other States	100,000	.....
Total	242,000,000	222,113,218

Melting points of refractory oxides, as determined by C. W. Kanolt, associate physicist of the U. S. Bureau of Standards shows magnesia (Mg 0) to be the most refractory with a melting point of 2800 degrees C. Lime (Ca 0) comes next at 2572 degrees C; alumina (Al_2O_3) melts at 2050, and chromium oxide (Cr_2O_3) at 1990 degrees C. A modified Arsem graphite resistance furnace operated in a vacuum was employed in the tests.

GENERAL PROGRESS REPORT OF JOINT COMMITTEE ON INDUCTIVE INTERFERENCE.

(This progress report is a resume of the work accomplished and the conclusions reached by this committee since the last progress report made which appeared in the October 4, 1913, issue of this journal.—The Editors.)

Since the last progress report the Joint Committee on Inductive Interference, authorized by the California State Railroad Commission, has given a great deal of consideration to the analysis of results obtained from the several parallels on which an investigation has been conducted, together with the preparation of a program of work to be carried out by the committee in the immediate future.

The parallels concerned in this study are described in the last progress report from the committee. The principal exposures are, briefly, two parallels, (20 miles and 8 miles), between the 57,000 volt 3-phase line of the Sierra & San Francisco Power Company and the main coast line toll lead of the Pacific Telephone & Telegraph Company between San Francisco and Los Angeles. In addition to the telephone lead, circuits of the Western Union Telegraph Company are paralleled by this line in portions of its length. The high tension line in question is supplied by auto-transformers at the Guadalupe substation and supplies 33,000 volt and 22,000 volt lines of the Coast Valleys Gas & Electric Company through auto-transformers at Salinas. South of Salinas, the above mentioned telephone lead is paralleled by the 33,000 volt line of the Coast Valleys Gas & Electric Company for a distance of 41 miles between Salinas and King City. The telegraph circuits of the Western Union Company are also exposed to this high tension line. In all cases the power and telephone lines are on opposite sides of a public highway. The Sierra & San Francisco Power Company operates with a grounded neutral. Tests were made under conditions of grounded and non-grounded neutral of the star-connected auto-transformers at Salinas. There are no grounds beyond Salinas in the 33,000 volt and 22,000 volt lines supplied by these transformers.

The mass of experimental data and the studies concerning these exposures are embodied in some 30 technical reports. Some of the general results and conclusions indicated by a study of these reports are as follows:

The fundamental, (60 cycle), wave of voltage or current is relatively of little importance in the production of noise in telephone circuits. It becomes of importance, however, if it gives rise to longitudinal voltages of sufficient magnitude to constitute a physical hazard, to interfere with the operation of grounded signalling devices or superimposed telegraph service, or to operate protective apparatus on the circuits.

The harmonics of the voltage and current waves are of chief interest as the cause of noise in telephone circuits, particularly the higher harmonics or those within the range of the voice frequencies.

The fundamental and lower harmonics are important as disturbing factors in telegraph circuits.

The above facts show clearly the great desirability, from the standpoint of inductive interference, of having wave forms of voltage and current in power circuits free from all harmonics. That such does not obtain in the present state of the art is a basic cause of the disturbance to communication circuits paralleled by power circuits. Further than this these facts emphasize the desirability that designers and manufacturers eliminate, as far as is practicable, these features of design favorable to distorted wave forms.

In order to facilitate the analysis of the inductive effects of a power circuit on parallel communication circuits, the voltages and currents of a 3-phase power system can be conveniently regarded as made up of components which exhibit distinct characteristics and treated separately. In any 3-phase system in which the three voltages between pairs of wires are equal in magnitude the voltage between any wire and ground can be considered to be the vector sum of two voltages which are called the balanced and the residual components respectively. The balanced components consist of three equal voltages between the three wires and ground, the vector sum of which is zero. The residual components consist of three equal voltages between wires and ground which are in phase with each other. The residual voltage of the system is defined as the vector sum of the voltages of the three conductors to ground. It is, therefore, three times the residual voltage of the individual conductors or three times the equivalent single-phase voltage of the three conductors in parallel with respect to the earth. The currents flowing in the three wires of a 3-phase circuit may be considered to be composed of three sets of currents, namely: (1) balanced components consisting of equal currents in each of the three line wires whose vector sum is zero. (2) a single-phase current flowing in a loop composed of two of the wires. (3) a residual current divided equally between the three wires and returning through the earth. Residual current is defined as the vector sum of the three-line currents. It is, therefore, the equivalent single-phase current flowing through the three-line conductors in parallel with the earth completing the circuit. Connections of current and potential transformers are arranged for measuring the residual current and residual voltage of power circuits under investigation.

For the purpose of clearness, it is convenient to classify induction phenomena as longitudinal or transverse referring to their manifestation on a metallic circuit. Longitudinal induced voltage refers to the voltage induced between the circuit and ground in the case of electrostatic induction and along the circuit between the two ends of the exposure in the case of electromagnetic induction. The transverse induced voltage of a circuit is the difference between the longitudinal induced voltages of the sides of the circuit. In the case of electrostatic induction this voltage acts between the two sides of the circuit and in the case of electromagnetic induction it acts around the metallic circuit.

It has been found in the case of the power lines investigated that the fundamental 5th, 7th and 11th harmonics are prominent in the balanced currents and voltages while the fundamental, 3rd, and 9th harmonics are prominent in the residual currents and voltages of the power system.

By a comparison of the prominent harmonics in

the currents and voltages of the power system with those of the induction in the telephone circuits it is evident that the longitudinal induction arises principally from the residual voltages and currents while the transverse induction shows principally the characteristics of the balanced voltages and currents together with some effect from the residual voltage and current.

The effect of the condition of the neutral of the anto-transformers at Salinas, grounded or non-grounded in so far as the induction from these exposures is concerned, is through the residual currents and voltages of the several high tension lines connected to these transformers. A representative value of the neutral current at Salinas during the tests conducted at that point is 0.3 ampere. It is composed almost entirely of 9th harmonic together with the fundamental and 3rd harmonics, decreasing in magnitude in the order named. The length of the power circuit between Guadalupe and Salinas is approximately a quarter wave length for the 9th harmonic. This fact may have some bearing upon its large magnitude and is to be further investigated by the committee. Under existing conditions with the power system in normal operation, grounding the neutral of the auto-transformers at Salinas does not greatly affect the induction in the exposures concerned. Two reasons may be given for this result: (1) the load balance on the power system is such that a relatively small amount of load current flows through the neutral, (2) as three high tension lines are connected together by the auto-transformers at Salinas, opening the neutral connection to ground of these transformers does not completely eliminate the path for the residual current of any one of the three lines, since it may then flow to earth through the admittance to ground of the other two lines. It is quite evident from these considerations that this case presents special conditions which make it impossible to draw general conclusions applicable to any other case. Further consideration of the effect of grounding this neutral will probably be undertaken by the committee with the idea of determining its effect under abnormal conditions.

The banks of star-connected auto-transformers at Guadalupe and Salinas substations are provided with closed delta secondary windings which supply power for local consumption. For test purposes the secondary delta of the transformers at Salinas was opened. A large increase in the residual voltage and residual current with a consequent large increase in the induction in parallel telephone and telegraph circuits resulted. In all cases this increase applied particularly to the 3d harmonic. If star-connected auto-transformers are used, this test indicates, therefore, that from an induction standpoint it is beneficial to provide such auto-transformers with secondary windings connected delta.

On the eight-mile exposure it was possible to measure separately under different conditions of the telephone circuits, the electromagnetic and electrostatic induction. For this exposure, also, computations of the magnitude of the induction, both electromagnetic and electrostatic, were carried out. In computations of electromagnetic induction, experience has indicated that the distances between wires and their images cannot be assumed to be twice the height of the wires above the ground. Special tests were carried out in order to determine the equivalent depth of the image conductors. The tests indicated this depth to be approximately 300 meters below the earth's surface. Due to the electrostatic shielding effect of neighboring objects it was found, also, that the computed electrostatic induction was greater than that actually observed, indicating that in effect the ground surface was brought nearer to the conductors. Electrostatic shielding of the circuits under test, by grounding other circuits on the telephone lead at one point, reduced the electrostatic induction, particularly the longitudinal induction.

The effect of typical terminal apparatus of a telephone circuit in reducing the amount of extraneous current reaching the telephone receiver was the subject of some investigation. These effects vary with the length of the line and character of the induction.

As a means of minimizing inductive interference, some study has been given to the proper relative transposition of power and telephone circuits. Some of the considerations involved in this study are given in the portion of this report dealing with the future work of the committee.

The field engineering staff of the committee is now located at Santa Cruz and is investigating the parallel between the 22,000 volt 3-phase line of the Coast Counties Gas & Electric Company and a toll lead of the Pacific Telephone & Telegraph Company. This parallel is between Santa Cruz and Watsonville and is approximately 17 miles in length, the two lines occupying opposite sides of the public highway. The system of the Coast Counties Gas & Electric Company is isolated from ground. The high tension line involved in this exposure may be taken out of service when occasion requires and used for experimental purposes.

The committee plans to conduct on this exposure a series of tests for the purpose of determining the effectiveness of several different systems of transpositions of the power and telephone circuits. In considering transposition systems for parallel power and telephone circuits account must be taken of the effect of such transpositions on the different types of induction arising from the different components of the voltages and currents of the power system. The longitudinal induction arising from balanced voltages and currents can be made as small as desired by the insertion of a sufficient number of properly located power circuit transpositions. The longitudinal induction arising from the residual voltage and current of the power circuit is unaffected by power circuit transpositions except in so far as the magnitude of the residual voltage and current is affected by such transpositions. Transpositions in a power circuit tend to equalize the capacities of the three-phases to ground and, hence, reduce any residual voltage which may be due to inequalities in the capacities of the three conductors to ground. Residual voltages and currents give the same inductive effects as a single-phase grounded circuit operating with the three power conductors in parallel. For this reason residual voltages and currents, though small in comparison with

the balanced voltages and currents, have proportionally a very large effect in producing longitudinal induction in nearby circuits. The longitudinal induction arising from either the balanced or residual voltages and currents is independent of the transpositions in the telephone circuits. The large inductive effects resulting from a relatively small residual voltage or current and the inability to reduce the longitudinal induction arising therefrom render highly desirable the elimination from the power system of such residual components of voltage and current. The transverse induction from residual currents and voltages can be reduced by transpositions in the telephone circuits which tend to equalize the induction into the two sides of the circuit by exposing each side equally to the effect of the power circuit. The transverse induction from balanced currents and voltages is affected by transpositions in both the power and telephone circuits.

The problem of designing transpositions to minimize the inductive interference between parallel power and telephone circuits is further complicated by the elaborate transposition system of the telephone circuits which is designed to reduce the induction or cross-talk between different telephone circuits. In order to be most effective in reducing inductive interference it is absolutely essential that the transpositions in the power and telephone circuits be located with due regard to each other.

By the experimental study of transposition systems being conducted at Santa Cruz, the committee hopes to be able to determine:

(a) The effect of power transpositions in reducing the longitudinal induction arising from balanced currents and voltages.

(b) The effect of telephone transpositions in reducing the transverse induction arising from:

1—Residual currents and voltages.

2—Balanced currents and vo'tages.

(c) The effect of power and telephone transpositions properly located with respect to each other in reducing both the longitudinal and transverse induction arising from balanced currents and voltages.

(d) The relative effectiveness of different transposition systems in reducing electrostatic and electromagnetic induction.

In its application to other exposures the infornation to be obtained from this experimental study will be chiefly of value in indicating the limits and refinements within which it is necessary to work and the accuracy with which the effectiveness of any proposed system of transpositions may be predetermined.

In addition to the study of the effect of transpositions the committee will undertake in the near future to determine the effect of known amounts of noise, (extraneous current), in the telephone receiver in reducing the intelligibility of conversation over a circuit. As the first step in this investigation, tests will be conducted to determine the detrimental effect of known amounts of single frequency extraneous current in reducing the intelligibility of conversation. This detrimental effect will be rated as the equivalent of an increase in the length of the circuit. From such tests with single frequency extraneous currents the relative detrimental effect of currents of different frequencies will be obtained. This, together with information as to the detrimental effect of currents of complex wave form, will give information by which the law of the combination of the single frequency effects can be obtained.

Until such time as the committee is prepared to make recommendations to the railroad commission it feels at liberty to indicate only in the most general way the results of its investigation. Since its formation, a year ago, the work of the committee has served to emphasize to all members the magnitude of the problem under investigation and the necessity of a thorough consideration of the subject in all its different phases, before the committee, in justice to itself and to the railroad commission of California can make final recommendation to that body for its action.

WISCONSIN COMMISSION TREATMENT OF MUNICIPAL PLANTS.

A public utility plant owned by a city should be treated as an enterprise separate and distinct from the city itself. All its accounts should be kept accordingly. In every respect the plant should be deemed an independent agency.

This is the conclusion of the railroad commission of Wisconsin in a recent case involving the rates of a municipally owned water utility. Wisconsin is one of the few states in which public utilities owned by municipalities are regulated by the state commission in exactly the same manner as privately owned public utilities. In this case the city of Sparta applied to the commission for authority to increase and readjust its water rates. The case was decided September 13, 1913, and is reported in 12 W. R. C. R., 532-547.

The commission states:

1. The city must pay the utility at a reasonable rate for all service rendered the city.

2. The utility must pay the city a reasonable amount as taxes and as interest on the city equity in the property of the utility.

3. The city must provide all funds for capital expenditures such as new extensions, retirement of bonds, etc.

Water damage to oil wells in the Coalinga field is being investigated by the California State Mining Bureau, which has issued a preliminary report. Flooding of oil sands by underground water is so serious as to threaten suspension of operations by several companies. An oil well commissioner is systematically gathering data and getting the co-operation of the operators in finding the cause of the trouble. In one well chemical corrosion of the well casing by "black sulphur water" admitted water which flooded six wells. Some wells have passed through oil sands which were not recognized as such; and these sands will be tested with the expectation of finding more oil than first calculations indicated. It has also definitely shown that water occupies the same sands that farther up their dip have produced oil, and that as the oil is removed the water gradually creeps upward along the stratum, making it necessary to shut off this particular bed to prevent its flooding the other sands which have not yet been drained of all their oil content. A noncorrosive casing, either painted or of a different metal, is suggested as a remedy.

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POWER AND GAS

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Safety First

The revolving of a myriad wheels of industry by that inexorable power made possible by the miracle of turning the waste of falling waters into the modern "juice" of comprehensive service; the consequent use of high voltage transmission; and that other miracle of rapid transportation which makes the seven league boots of childhood's wonderment fade into insignificance, are all fraught with the necessity for exercise of increasing vigilance that safety be assured.

This need for industrial safety in all departments has been crystallized into the slogan "Safety First," which together with the activities it involves, is being universally adopted as a badge of assurance by all those individuals and corporations whose employment is hazardous to life.

They who preach the certitude of protection afforded by the doctrine of safety are the apostles of prevention.

"Safety First" is the expression of an instinctive trait of self-preservation, though it also includes as a matter of development, the humanitarian viewpoint which places the safety of others before the self indulgence of apathy and carelessness.

"Safety First," movements usually commence with the employe, but it is equally certain, where the public are party to the activities of the corporation, that the effective education of that public is of equal importance if the number of accidents is to be reduced.

It is said that when railways were first introduced into Italy the peasants, whose simplicity and lack of education gave them no conception of the momentum of a great mass travelling at high velocity, were not infrequently run over. Although on matters so simple, general knowledge is in this country sufficient, there are still many matters upon which public education is needed. Forewarned is forearmed.

The education of the child as a primary precaution in the prevention of accidents will be always necessary.

Adults need to know the danger of the misuse or abuse of electricity and the necessity for taking precaution to protect themselves from possible accidents when travelling. Each and all must do their part, though the travelling man is a preferred "risk."

The closer contact and experiences of the employe, give him a better knowledge of deficiencies or conditions which might cause accidents, than the official higher-up has who would be held responsible should such accidents occur. With the detection of what is wrong comes almost invariably knowledge of that which should take its place. To this end, corporations and employers generally have sought the co-operation of their employes, who have been urged to report defective tools, machinery, cars, tracks and all other matters the remedying of which might prevent accidents.

It has been objected, on the ground that it meant "spying on fellow employes," that to direct attention to the non-use or mis-use of accident preventing methods and devices, could not be countenanced. On the other hand, a broader view of the matter shows the

interdependence of all and that as a matter of self preservation, as well as from the humanitarian viewpoint, such action is commendable and not contemptible as previously supposed.

An accident having occurred, "safety first" requires knowledge also of those methods by which life may be preserved, such as resuscitation from shock, first aid to the injured and so forth.

"Safety First" also calls for the use of all those mechanical devices which will minimize the hazard of employment. Then when all this has been done there has still to be reckoned the recklessness and daring bravery also of the human element which hopes that in some manner their rash act or indifferent will escape the consequence. But at some time the pitcher is taken to the well for the last time and nothing but broken fragments bear witness to a usefulness destroyed.

So the toll of deaths and the expense of accidents will never be entirely eliminated until individuals recognize their full responsibility, and safety first, last, and all the time, becomes instinctive.

Central Station Merchandising Methods

Some central stations endeavor to secure all the lamp business resulting from their operations. Campaigns are also carried on for the purpose of selling appliances. This merchandise is usually offered at cost, or at an increase in price which does not permit a fair profit for handling the business.

Lamps of poor quality resulting in poor lighting service was the excuse for the central station engaging in the distribution of lamps, but a product universally improved has removed that necessity.

This, together with the more general use of appliances is reason sufficient for the discontinuance by central stations of such sales. All dealers in goods electrical now carry stocks of approved appliances and these would undoubtedly be larger if more business were assured. There can be now no suspicion on the part of the central station that orders turned over by them to the contractor or electrical supply house will not be properly and promptly filled.

A central station can show interest in its customers by disseminating information among them regarding the scope, use and desirability of electric appliances; the proper method of installing and the economical use of electric lamps. Such educational work is a legitimate sales expense and where invention causes such rapid changes and the sale of product (energy) is practically perpetual, it should certainly become an important item in central station service.

The central station should create business for those concerns legitimately engaged in the sale of electric lamps and appliances, for such co-operative effort would give even greater returns.

Increased current consumption without any appreciable increase in investment is the principal advantage to the central station.

Public service commissions have gone on record as being in favor of regulated monopoly of public utilities, but as opposed to the principle of serving any customer at less than cost on the grounds that other customers have to bear the burden of loss. A fair return upon its investment is assured the utility.

But all consumers do not use lamps or those current consuming appliances sold by central stations, hence the further injustice of their selling these commodities at cost—or, in other words, at a loss.

Public service commissions should insist upon the discontinuance of such merchandising methods and in fixing prices at which these commodities shall be sold by central stations should consider the fact that a large part of the business of electrical supply houses is in these very things. If they permit a monopoly to secure business at cost or with a minimum amount of gross profit, to that extent they do an injustice to legitimate electrical supply houses.

Proper School Room Lighting

Due to careless planning of both daylight and artificial illumination of school rooms, the question, "Can you see the black-board from where you sit?" became a common expression among school teachers. It was not only common, but incorrect. They knew well enough that the board could be very well seen from any part of the room. The actual information desired was, whether or no all could see the chalked figures on the board—an entirely different matter.

These black-boards usually faced the windows and being smooth and sometimes polished with use, reflected specularly practically all the light falling on them, with the result that there was then no contrast between the white chalk marks and the "black" board. Consequently the marks could not be distinguished.

During the winter months and at night school conditions were not vastly different. Bare light sources, usually flickering, open flame gas burners, gave a very low intensity of illumination on the desks and did not mitigate the evil of glare.

This was emphasized considerably by the use of highly glazed paper for books and for writing purposes. Altogether, conditions were not conducive to efficient study.

Young people gave up their evening studies early because of headaches really resulting from bad lighting conditions though attributed to too prolonged study—working during the daytime and studying at night.

The difficulties attendant have been recognized and this is the first step toward their elimination.

Progress along this line has however been halting. While in some places it has received considerable attention and the best possible results secured, the great bulk of school room lighting is still inadequate, inefficient and obstructive.

A description of proven satisfactory school room lighting is given under Lighting Methods in this issue. It is by no means the only method but shows how this problem may be satisfactorily solved.

To the practicing illuminating engineer or lighting specialist this article has the added value of showing how this type of asymmetrical unit should be installed. To the uninitiated this is usually a serious stumbling block in planning this method of lighting. The data is well worth filing.

PERSONALS

ITEMS FOR THIS DEPARTMENT ARE SOLICITED FROM ALL READERS

E. J. Nally, president of the Marconi Wireless Company of America, is at San Francisco.

Joseph S. McKnight, agent for the Utah Power and Light Company at Vernal, is visiting in Salt Lake City.

T. M. Robinson, city engineer of Fresno, Cal., spent a few days at San Francisco the latter part of last week.

E. C. Estep, telephone specialist of the Western Electric Company, New York, was a visitor at San Francisco last week.

W. G. Higgins, superintendent of supplies, Western Union Company, New York, was at San Francisco during the past week.

A. E. Roome has been appointed general manager of the Pacific Electric Railway Company, vice H. L. Metcalf, deceased.

R. Clapp, former Jovian Statesman for Southern California, was a visitor at San Francisco from Los Angeles during the week.

A. Patzer of the Patzer Electrical Works at Stockton, California, spent a few days at San Francisco during the past week.

C. W. Whitney, Natomas Consolidated of California, attended the Industrial Safety Convention at the University of Nevada.

P. Sheedy, superintendent motive power, Southern Pacific Company, Los Angeles, was at San Francisco during the past week.

H. C. Hazzard, secretary, Pacific Coast Electric Railway way Association, was at San Francisco from Portland during the past week.

A. May of the San Diego Consolidated Gas & Electric Company, has been appointed Jovian Statesman for San Diego, California.

A. V. Olson, of Pass & Seymour, Inc., San Francisco, is taking a five weeks' business trip throughout the southern part of California.

T. T. Frith of Butte, Montana, was at San Francisco attending the convention of the Fire Underwriters' Association of the Pacific Coast.

Miles Steel, salesman, Benjamin Electric Manufacturing Company, is at Los Angeles on business and will spend some time in Southern California.

R. M. Alvord, A. V. Thompson and **A. G. Jones**, General Electric Company, San Francisco, attended the Industrial Safety Convention at the University of Nevada.

L. R. Elder of the Portland office, **E. C. Fellows** of Seattle, and **H. M. Hall** of the Los Angeles office, General Electric Company, were visitors at the San Francisco office during the past week.

Joseph S. Sands, salesman of the Westinghouse Electric and Manufacturing Company in their Denver office, is in Salt Lake City for a few days in connection with some special work for the company there.

A. D. Page, sales manager, Edison Lamp Works of General Electric Company, will attend the next meeting of the Pacific Coast Electrical Jobbers' Association to be held at Del Monte during March.

W. C. Orem, president Salt Lake and Utah Interurban Railroad Company, was at San Francisco last week inspecting the new gasoline motor cars being built for temporary use until completion of electrical equipment of his line.

C. H. Carter of the Pacific States Electric Company, Los Angeles, has left for the East, where he will attend the National Jobbers' Convention at Washington, D. C., and also visit the various manufacturers represented on the Pacific Coast.

Chas. N. Black, vice-president and general manager of the United Railroads, has left for New York to attend the semi-annual session of the executive board of the American Electric Railway Association of which Mr. Black is president.

R. T. Kahn, until recently connected with the lamp department of General Electric Company, San Francisco, will be one of the city salesmen with Holabird-Reynolds Company, vice **W. Tardiff**, who has been transferred to the new Oakland Branch.

T. H. Macdonell is now president of the California Electric Construction Company, vice **R. L. Wolden**, who will now engage in an electrical brokerage business at room 4, 641 Mission street. **C. L. Chamberlin**, for some years past connected with the company, will be manager.

C. W. Hutton, Pacific Coast agent of the General Vehicle Company, made Salt Lake City this week on his regular trip over the Northwest territory. He reports increased interest all through the territory in the electric vehicle as a result of the many installations which are giving satisfaction.

R. L. McBride, associate chemist for the Bureau of Standards at Washington, D. C., is making a study of gas conditions in California with particular reference to arriving at a proper standard for heating value in Oregon. Mr. McBride spent the past week in San Francisco and will return to Washington by way of Los Angeles.

Frank B. Whipple has been appointed vice-president of the San Francisco-Oakland Terminal Railways, succeeding **J. K. Moffitt**; **A. W. McLimont** has been appointed general manager; **Robt. Morrison Jr.**, secretary, and **Kirke Lathrop**, treasurer. **W. R. Alberger**, who was general manager, remains as vice-president of the company, and **F. W. Frost**, who resigned from the position of secretary-treasurer, will remain with the company in an advisory capacity.

Raymond E. Dresser, commercial engineer, power division, Utah Power and Light Company, has been appointed division manager of Southern Idaho, with headquarters at Montpelier, Idaho. Mr. Dresser is a graduate of the University of Utah, and completed the apprenticeship course in the Westinghouse works. After returning to Salt Lake City, he occupied various positions in the commercial department of the Utah Light and Railway Company, until a year and a half ago, when he entered the service of the Utah Power and Light Company.

W. H. Bancroft, president Utah Light and Railway Company, vice-president and general manager of the Oregon Short Line Railroad Company, and vice-president of the Salt Lake Route, has been relieved from his duties as general manager of the Oregon Short Line, at his own request. He will still continue as president of the Utah Light and Railway Company and vice-president of the Salt Lake Route. Mr. Bancroft is seventy-four years of age, and has been eligible for retirement for the last ten years, but has preferred to stay in harness until the present time, when he felt that in justice to himself he should relinquish a part of the arduous duties which he has carried for the past several years. Mr. Bancroft entered the railroad service in 1856 as telegraph operator and ticket clerk for the Michigan Southern Railroad, and has been continually in that service to the present time, rising through the various grades to the executive head of all of the Harriman interests in the intermountain territory. When the Harriman interests acquired control of the Utah Light and Railway Company in November, 1906, Mr. Bancroft was appointed president, and immediately entered upon the difficult task of reconstructing the system which had been allowed to depreciate until the physical value of its property was almost nil. During the past seven years, $7,000,000 have been expended on the system under his personal direction, and today Salt Lake City can boast of a street

railway and electric light and power system second to none in the country. The relinquishment of his duties as general manager of the Short Line will give Mr. Bancroft more time to devote to the details and management of the Utah Light and Railway Company, in which he has always been greatly interested.

OBITUARY.

W. P. Monahan, an engineer, graduate of the Boston Technical College, and for two years in the employ of the Stone & Webster Construction Company, was drowned on the 25th of January, 1914, while attempting on a horse to ford a creek near Webstone, in the Sierra Nevadas, thirty-six miles from Fresno, Cal. Mr. Monahan had been complaining of illness and started from the mountain construction camp to Fresno. His body was found the following day in Jose creek.

MEETING NOTICES.

The Jovian Electrical League of Southern California.

At the regular meeting at Christopher's on Wednesday, January 21st, G. E. Arbogast was the chairman of the day. There was an attendance of about 125 members and visitors. A. F. Rosenheim, F. A. I. A., gave a very interesting address on "The Architect," and urged very strongly the necessity for concerted action in securing a civic center in Los Angeles, with proper architectural harmony.

1914 Convention Illuminating Engineering Society.

At the last executive meeting of this society it was arranged to hold the eighth annual convention at Cleveland, Ohio, during September of this year. Clevelandites are very enthusiastic over the arrangement and expect to make the 1914 Cleveland Convention memorable as the best ever held by the Society.

The ninth convention in 1915 will be held at ——— (wake up, San Francisco, 1915.)

Organization Dinner International Electrical Congress.

An organization dinner for the discussion of plans for the International Electrical Congress at San Francisco in September, 1915, is to be held at the Engineers' Club, New York City, Tuesday evening, February 24th. Invitations will be issued to members of the Congress General Committee of 150, to members of committees of the American Institute of Electrical Engineers and officers of the Institute and its sections.

San Francisco Electrical Development and Jovian League.

On Tuesday, January 27, 1914, the after luncheon talk at Tait's was given by W. L. Goodwin, on the subject of "Salesmanship." The subject and the speaker drew a large attendance and additional tables were requisitioned. The paper, which was divided into two parts, first dealt with an analysis of salesmanship and the development of salesmen as applied to the electrical supply business, and second, with nifty lessons on salesmanship, or getting the order by the "Do and Don't Route." It was both helpful and inspirational and was well received by the many members present. Mr. W. F. Neiman was chairman.

Seattle Jovian League.

The members of the Jovian Order met Friday, January 23d, at the Rathskeller Cafe with about seventy-five members present. The feature of the after lunch talk was a few words by Mr. J. D. Ross, superintendent of the city light plant. Mr. Ross dwelt particularly on the progress of the municipal light business and stated that 4½ per cent of the current now used in the city of Seattle was furnished by the city plant, and since its conception rates have been gradually reduced in the city until at this time for residences we have a six cent light rate and a three cent heating rate.

Utah Electric Club.

At the regular meeting of the Utah Electric Club in the gold room of the Commercial Club, Thursday, January 22nd, at 12:30, J. C. Jones, chairman, presided. H. S. Sands of Denver outlined plans for the consolidation of the Colorado Electric Club with the Traffic Club of Denver. The new club will be known as "The Electric and Commercial Club." and the former members of each will have the full privileges of the commodious quarters of the Chamber of Commerce Building on Champa street.

The regular speaker of the day was W. S. McCarthy, traffic manager of the Salt Lake Hardware Company, and secretary of the Commercial Club Traffic Bureau of Salt Lake City. He spoke on the subject "Recent Rulings of the Interstate Commerce Commission Affecting Intermountain Traffic." He outlined the work of the Traffic Bureau, leading up to the ruling of the Interstate Commerce Commission about a year and a half ago, effecting a reduction of 15 per cent in glass rates and 35 per cent commodity rates to intermountain points, and indicated some of the adjustments which were still necessary to equalize some of the traffic conditions now existing.

Engineering Meeting at University of Idaho.

On Saturday, January 17, the Spokane Section of the A. I. E. E., the Spokane Chapter of the A. S. C. E., and the Columbia Section of the A. I. M. E. held a joint meeting with the Faculties of Engineering and Engineering Students of the University of Idaho and the Washington State College at Moscow, Idaho. This was in the nature of a "get together" meeting, for the purpose of allowing the practicing engineers to get in touch with engineering education in this section, and to enable the students to get in touch with engineers who have left their college days behind them, and become seasoned to the practical work of life.

At 3:30 the afternoon session commenced in the University auditorium. Mr. L. K. Armstrong of Spokane, (A. I. M. E.) presided. A paper was presented by Mr. J. C. Ralston of Spokane (A. S. C. E.) upon the factors involved in the preparation of an estimate for a municipal hydroelectric plant for a city of 125,000 inhabitants. This was discussed by Mr. C. S. MacCalla, general manager of the Washington Water Power Company, by Mr. Morton McCartney, city engineer of Spokane, by Mr. J. E. Moody of the firm of Hurley-Mason Company, contractors. Mr. Ralston's paper touched not only upon the various features of an ordinary project, but the added influence of politics, city wage scales, bonds, etc., upon the cost. Mr. MacCalla spoke of the extreme difficulty experienced in getting definite information before commencing work, not on what the project "ought to cost" but in what it will cost, which is the feature which affects the public or the stockholder. Mr. McCartney emphasized the division demarcation of the paper into technical, political, financial, and eccnomic features. Mr. Moody touched upon the difficulties of the contractor in interpreting or following contradictory clauses in specifications, and the injustice of so many corporations, in their specifications, in refusing to guarantee the work of their engineers, but making the contractor take the responsibility. Members of the faculties of both institutions joined in the discussion, calling attention to the fact that the technical was one part only of the engineer's work, and that there are other talents to be developed before success in engineering is possible.

Mr. F. A. Ross then presented a paper descriptive of the Wood system of Surface Tension Flotation which was discussed by members of the A. I. M. E. present. Prof. R. S. McCaffery was asked to tell something of his investigations on the electrothermic separation of lead and zinc ores at the University of Idaho. He outlined in a few minutes the results aimed at, but stated that sufficient progress had not been made as yet to render definite conclusions possible.

At 5:30 the meeting adjourned to the dining room of Ridenbaugh Hall where a trencher test was conducted by the Engineering Faculty of the University to the complete satisfaction of all concerned so far as known.

At 7:30 the engineers returned to the Auditorium where they listened to an illustrated paper on the Little Falls Tie Line by Mr. J. B. Fisken, superintendent of light and power for the Washington Water Power Company. The time being late, discussion was cut short, and the visitors repaired to their respective trains. It is hoped that more meetings of this nature will be held in the future, alternating between the Washington State College and the University of Idaho.

DOING IT ELECTRICALLY AT ABERDEEN, WASH.

Tuesday, January 13th, was suddenly turned into a holiday for those engaged in the electrical industry in Aberdeen, Wash., when it was discovered that nine traveling salesmen, representing as many different electrical jobbing houses and manufacturers had arrived in town during the morning and evening before, each without knowing that he would meet any competition in the field.

There are three electrical concerns in Aberdeen, The Grays Harbor Railway & Light Company, The Electric Service & Supply Company, and The Aberdeen Electric Company. All the available business was corralled and the balance of the day was utilized in educating candy store clerks, tenders of soda fountains, and so forth, to "Do It Electrically."

In the evening the boys banqueted at the Hotel Washington, after which J. C. Bird, the man with the Paderwiski Movement, manipulated the ivories, while Jack Landerkin

Raincoats Prove That Aberdeen Is Not "Dry."

rendered several ballads for the entertainment of the guests, (some of them were still there when he finished.)

The picture herewith was taken by the writer (W. S. Mendenhall, sales manager The Electric Service & Supply Company), in front of the Electric Building. It shows eight of them, Frank J. Zorn could not be located and we all had a strong suspicion that he was out trying to impress some Mill-Man with that "Guarantee of Excellence," which he always carries on his shoulder like a chip. From left to right they are: H. R. Miller of the Northwestern Supply Company, Seattle; C. A. Norton of the Westinghouse Electric & Manufacturing Company, Seattle; W. N. Landerkin of the Pacific States Electric Company, Seattle; M. H. Nichols of the Western Electric Company, Seattle; W. B. Thomas of North Coast Electric Company, Seattle; J. W. Leighton of the Every-Ready Dry Battery Company, Portland; J. M. Chamberlain of Fobes Supply Company, Portland; J. C. Bird of Westinghouse Lamp Company, Seattle.

The boys all wished a copy of the picture forwarded to the Journal and no doubt they will be recognized by their many friends throughout the coast territory.

PACIFIC COAST MEMBERS SOCIETY FOR ELECTRICAL DEVELOPMENT.

That considerable interest has been aroused in this Society is evidenced by the splendid representative membership of Pacific Coast firms as given below. It should be noticed that national companies with Pacific Coast offices are not included and only one office is given for local companies maintaining offices in several cities.

Albany Elec. Supply Company, Albany, Ore., J.
Burkhart Elec. Works, Palo Alto, Cal., C.
Capital Electric Company, Salt Lake City, Utah, J.
Comet Electric Company, Eugene, Ore., C.
Electric Appliance Company, San Francisco, Cal., J.
Electric Corporation, Los Angeles, Cal., J.
Electric Lighting Supply Company, Los Angeles, Cal., J.
Electric Shop, Riverside, Cal., C.
Flagstaff Elec. Light Company, Flagstaff, Ariz., CS.
Fobes Supply Company, Portland, Ore., J.
Fyhn Electric Company, Brigham City, Utah, C.
Gilson Elec. Supply Company, Oakland, Cal., J.
Glendale Elec. Light Dept., Glendale, Cal., CS.
Grays Harbor Ry. & Light Company, Aberdeen, Wash., CS.
Green, C. F., San Pedro, Cal., C.
Haller-Cunningham Elec. Co., San Francisco, Cal., C.
Hanbridge, W. S., San Francisco, Cal., C.
Hillman Electric Company, No. Yakima, Wash., J.
Holabird-Reynolds Elec. Company, Los Angeles, Cal., J.
Hunt, J. A., Pleasanton, Cal., C.
Independent Elec. Company, Twin Falls, Idaho, J.
Inter Mountain Elec. Co., Salt Lake City, Utah, J.
Jacobs Electric Company, S. Pasadena, Cal., C.
Journal of Electricity, Power and Gas, San Franisco, Mis.
Kirkpatrick, James Q., Los Angeles, Cal., M.
Knight & Company, E. L., Portland, Ore., C.
Kohlwey Light Company, W. D., San Francisco, Cal., C.
Levy Electric Company, San Francisco, Cal., C.
Lockwood, C. M., Salem, Ore., C.
Montana Electric Company, Butte, Mont., J.
Mullins Electric Company, Wm. A., Taacoma, Wash., C.
North Coast Electric Company, Seattle, Wash., J.
Pacific States Electric Company, San Francisco, Cal., J.
Paine-Bailey & Company, San Francisco, Cal., C.
Panama Electric Lamp Company, San Francisco, Cal., J.
Paul, B. W., Portland, Cal., C.
Pierce Tomlinson Elec. Co., Portland, Ore., C.
Pomeroy, J. G., Los Angeles, Cal., C.
Pope, Harry D., Boise, Idaho, C.
Richmond Elec. Company, Richmond, Cal., C.
Rockwell-White Power & Light Company, Bellevue, Idaho, CS.
Russell Elec. & Machine Company, Tucson, Ariz., C.
Santa Paula Elec. Works, Santa Paula, Cal., C.
Sheridan County Electric Company, Sheridan, Wyoming.
Silver City Power Company, Silver City, New Mexico, CS.
Tillamook Elec. Light & Fuel Company, Tillamook, Ore, CS.
Truckee River General Electric Company, Reno, Nev., CS.
Tucson Gas, Elec. Light & Power Company, Tucson, Ariz., CS.
Vandegrift, J. A., Oakland, Cal., M.
Walsh Company, M. J., Portland, Ore., J.
Wenatchee Valley Gas & Elec Co., Wenatchee, Wash., CS.
Western Transformer Company, Oakland, Cal., C.
Wilson, J. E., Los Angeles, Cal., J.
Woodill & Hulse Electric Company, Los Angeles, Cal., J.

INLAND WATERWAYS ASSOCIATION OF CALIFORNIA.

This association is carrying on an active membership campaign which includes also an appeal for funds to carry out the purposes for which it was formed—"The furtherance of navigation by means of inland waterways, and the investigation, co-operation, and promotion of navigation, water storage, flood water control, irrigation, drainage, reclamation and kindred subjects, all being related or incidental to the primary purpose of inland waterways, navigation. The officers are: Wm. R. Wheeler, president; Chester H. Rowell, first vice-president; Mrs. E. G. Greene, Stanford University, second vice president; J. L. Craig, treasurer; and David H. Walker, San Francisco, executive secretary.

INTERNATIONAL ELECTRICAL CONGRESS.

The executive committee of the International Electrical Congress to be held at the Panama-Pacific International Exposition in September, 1915, has fixed the price of membership in the Congress at $5, entitling the member to one general volume and four section volumes, paper bound; with the additional volumes at the rate of $1 each, and $10 for the entire set of thirteen volumes. These prices are for paper bound copies. For books bound in cloth an additional charge of 50c per volume will be made. To this is to be added a fee of $1 per member to cover the bare cost of shipment. An organization dinner is to be held at the Engineers' Club in New York City on February 24th, when John A. Britton of San Francisco is expected to address the meeting.

INDUSTRIAL

STANDARD SIZES OF CONDUIT.

Recognizing the necessity and desirability of accurate data in reference to the proper size of conduit to be used in the installation of wires and cables, the National Electrical Contractors' Association has prepared a set of six charts showing this information in detail and in full size.

The disposition in the past has been to use conduits of too small interior diameter, and in the preparation of these charts care has been taken to recommend conduits of sufficient size to cover all working conditions, and at the same time having in mind that economy in installations should be considered and extravagant sizes in conduits not recommended. It is felt that the sizes recommended are sufficiently large and at the same time conservatively calculated.

The charts were prepared after long and careful study of the actual conditions encountered in making installations, and they have been officially adopted by the National Electrical Contractors' Association as a standard.

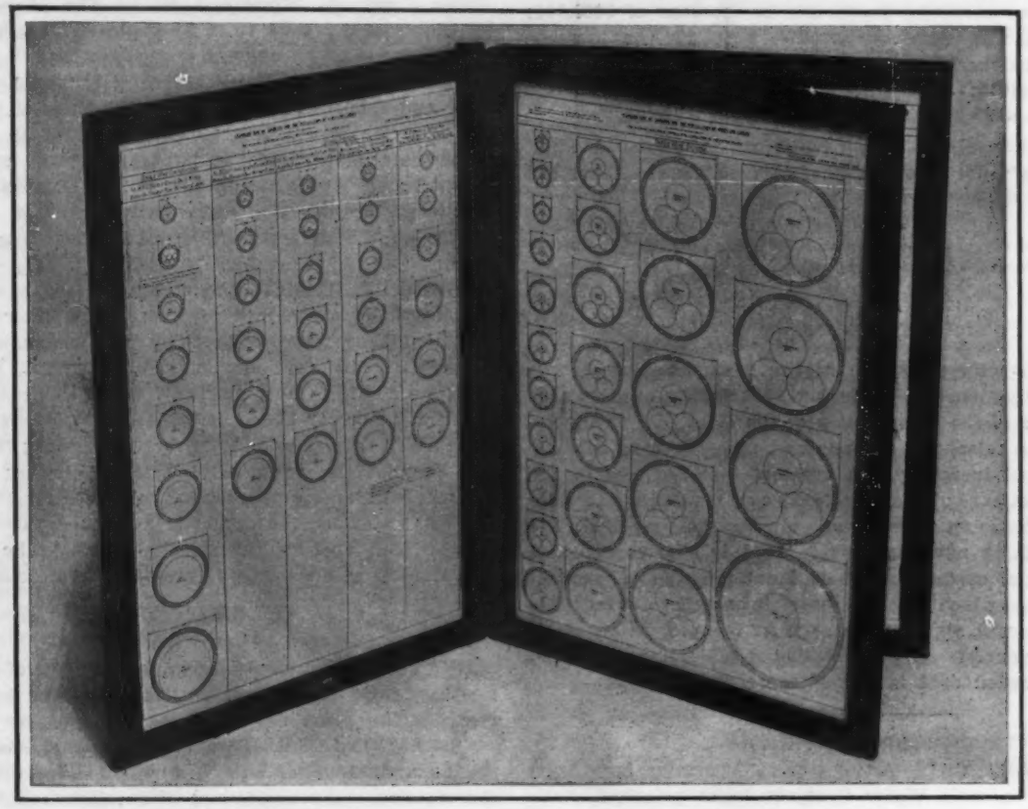
They show the conduit and conductors full size so that you have the actual condition before you, and the form of the chart is shown by the cut on page two which is reduced somewhat over two-thirds in size. The prints are made from plates so that there can be no variation from the actual size.

In addition to showing the size of the conduit needed for each combination of wires, the chart also gives the actual external diameter of the conduit and the carrying capacity of the wires used in accordance with the changes made in the National Code this year.

This covers practically all the data required for any installation of wires in conduit and presents it in a form most convenient for use.

The advantage of a standard system is self evident from the standpoint of the architect, engineer and contractor, and it is the hope of the National Electrical Contractors' Association that those having to do with the installation of conduits will accept the charts as prepared, and write into their specifications that "all sizes of all conduits shall be the N. E. C. A. standard.

The charts are substantially framed in wooden frames hinged together and provided with a backing board for convenient hanging. There will be three in the complete set, two charts being mounted on each sheet, and each chart is marked with the name of the system shown on the reverse side.



Conduit Charts Showing Their Arrangement for Easy Reference.

The National Electrical Contractors' Association has borne the work and expense of the preparation of these charts and in the interest of standardization is prepared to furnish the sets at the actual cost of producing them.

TRADE NOTES.

The Oregon Electrical Contractors' Association has issued a price and reference sheet for distribution among architects and electrical contractors. This price book in addition to prices has a large amount of valuable data and trade information. A copy of this book may be obtained free upon application to F. C. Green, secretary, 291 E. Morrison street, Portland, Ore.

T. R. Cornick has secured the contract for building "forty-three miles of 44,000 volt wooden pole transmission line for the city of Kamloops, B. C." DuCane, Dutcher & Company of Vancouver are the engineers handling this work for Kamloops; they are also in charge of the building of the power house, substations and auxiliary steam plant. This work will start in the early spring.

NEWS NOTES

FINANCIAL.

SAN FRANCISCO, CAL.—Treasurer McDougald has disposed of the last of the $653,000 of 5 per cent Municipal Railway bonds which had been turned over to him by the supervisors, all of them being sold at a sufficient premium to make the net interest upon the purchasers' investment 4.90 per cent.

SEATTLE, WASH.—The Puget Sound Traction, Light & Power Company report for the year ended December 31 shows: Gross earnings, $8,613,599, an increase of $299,751; net earnings, after taxes were paid, $3,605,224, an increase of $63,675; balance, after charges were paid, $1,793,188, an increase of $4615; bond sinking fund, $251,583, an increase of $27,709; surplus, $1,542,205, a decrease of $23,094.

SANTA ROSA, CAL.—The California Telephone & Light Company has reported to N. W. Halsey & Company for the year 1913 as follows:

	1913.	1912.	Increase.
Gross earnings	$105,679	$90,485	$15,193
Operating expenses, maintenance and taxes	59,804	50,375	9,429
Net income	45,874	40,110	5,764
Interest	21,000	21,000	.....
Balance	24,874	19,110	5,764

The satisfactory increase in the company's revenue is significant of the activities during 1913 in the development and extension of the consumption of the electricity in its territory. While telephone revenue and miscellaneous revenue showed normal increases, the greatest increase was in the electric operations, amounting to 22 per cent increase over the gross revenue from this source during the year 1912. The cost of obtaining new business in 1913 is also reported, it being an initial expense which will not recur in subsequent statements in which the increase in earnings from this new business will appear greater than the proportion of increase in expenses. At present the annual interest on the company's bonded debt is earned more than double.

INCORPORATIONS.

SANTA ANA, CAL.—Articles of incorporation have been filed by the Valencia Water Company, with principal place of business at Orange, Cal.

CUCAMONGA, CAL.—Alta Loma Water Company has been incorporated and has taken over the well on S. Johnson's place. About 7000 ft. of 5 in. pipe will be purchased and laid by the company before beginning of the irrigating season.

ILLUMINATION.

AMUSVILLE, ORE.—The electric light franchise up before the city council for the last two months, has been granted to the Amusville Flour Mills of this place.

VAN NUYS, CAL.—The contract for installing an ornamental lighting system at Ocean Park has been let to J. A. Bailey of Van Nuys. The electroliers will be of the 5-cluster type.

SAN BERNARDINO, CAL.—Plans for doubling the capacity of the electric plant of the Southern Sierras Power Company at Barstow at once, and the extension of distributing system to cover the entire city, are announced by W. M. Brison, district manager.

SAN RAFAEL, CAL.—Sealed bids will be received until February 2 for the erection of the concrete bases of 97 electrolier posts along Fourth street and the installation of an underground conduit system in three circuits for supplying electric current to 97 five-light electroliers.

WALLOWA, ORE.—With a view to the establishment of a municipal electric light plant, the city council has employed L. A. Reinaman, a civil engineer at Freewater, to make a survey and estimate the cost of the project, it being understood that the survey will be made as soon as weather conditions will permit.

EVERETT, WASH.—A reduction of 20 per cent in the price of electricity used in Everett's homes is announced by Manager D. C. Barnes of the Everett Railway, Light & Water Company, effective April 1. The charge now made by the company runs from 11 cents per kw.-hr. down to 8 cents, depending on amount of current used.

SEATTLE, WASH.—Effective February 1 and affecting rural and suburban districts near the lines of this company, and applying to all bills for service for both old and new subscribers to the electric light and power current of the Puget Sound Traction, Light & Power Company, during the month of February. The maximum rate of 10 cents per kw.-hr. on the date named will be reduced to 8 cents per kw.-hr.

RUPERT, IDAHO.—The heating of the new high school by electricity is the first case on record where large buildings have been heated entirely by such means, announces the Federal Bureau of Education at Washington. Besides being used for heating, the electricity, which is generated from a government power house, is utilized everywhere in the building. A ten horsepower motor, besides driving the ventilating fan, supplies the power needed for the lathes and saws in the manual training department. An electric heater supplies the hot water for the domestic science department, for the shower bath and for the science rooms. The bureau says that the use of electricity is proving a real economy.

TRANSMISSION.

VANCOUVER, WASH.—The power plant of the Washington-Oregon Corporation on the Kalama River was burned recently. The plant developed 2000 h.p.

LEBANON, ORE.—Scroggings & Washburn, owners of the Lebanon Lumber Mill, have applied for a franchise for the erection and maintenance of an electric light and power plant within the city limits.

KLAMATH FALLS, ORE.—The council instructed the city engineer to make a valuation of the old Ankeny ditch, owned by the government, as a step toward the construction of a municipal light and power plant.

SAN FRANCISCO, CAL.—The Secretary of Agriculture has granted during the past week rights of way for power transmission lines through National forests in California to the Pitt River Power Company, and the Pacific Light & Power Corporation. The Pitt River Company's right of way is for a power line approximately five miles long on the Shasta National Forest. The company applied under the act of March 4, 1911. In this case the grant was made upon the Forester's recommendation for the full 50 year period.

BOISE, IDAHO.—Thirty million dollars in bonds is involved in a suit to foreclose a mortgage which has been filed in the Federal Court here by the Guaranty Trust Company of New York against the Idaho Railway, Light & Power Company, the Idaho Traction Company, the Westinghouse Electric & Manufacturing Company and E. H. Jennings. The Westinghouse company filed at the same time a petition praying for permission to file a bill to foreclose a mortgage held by that concern against the property of the Idaho Railway, Light & Power Company for $40,761 for material alleged to have been furnished. The mortgages cover as well real estate in Silver City, the Tip Top mining property,

the Beaver River Power Company and their respective holdCaldwell extension of the interurban line, the Caldwell Power Company's plant, the Idaho-Oregon Light & Power Company's holdings, the Idaho Power & Light Company, formerly the Beaver River Power Company and their respective holdings.

SAN FRANCISCO, CAL.—With regard to the merger of the Northern California Power Company and the Oro Electric Corporation, H. H. Noble, president of the former company, issued the following statement: "Negotiations looking to the consolidation of the Northern California Power Company, Consolidated, and the Oro Electric Corporation, have reached the point where it can be definitely stated that this will be brought about through the agency of a new corporation, to be formed to take over the two companies in question. This amalgamation will be very advantageous to both companies as the Northern California Power Company, Consolidated, at the present time has a large surplus of power and the Oro Electric Corporation is now purchasing power from other companies, and has already contracted for a large amount of power to be connected up this spring. The consolidation will be advantageous from other points, as there can be a great saving in the operating expenses over those of the present. The dredging properties of the Oro Electric Corporation have not been included in the consolidation."

TRANSPORTATION.

PORTLAND, ORE.—Senator Jones has introduced a bill granting the Washington-Oregon corporation the right for an electric railroad, telegraph, telephone and electric transmission lines across the Vancouver military reservation

HEALDSBURG, CAL.—A. D. Bowen, the contractor and builder of the Petaluma and Santa Rosa electric line, is promoting a project for a trio of electric lines radiating from this city to Dry Creek Valley, Alexander Valley and down the Russian River.

RED LODGE, MONT.—A. J. Showalter, agent for the Red Lodge Electric Railway Company, who is promoting the sale of stock for the building of the trolley line from Red Lodge to Washoe and Bearcreek, has returned to this city and has reopened the campaign.

SAN FRANCISCO. CAL.—The stockholders of the Presidio & Ferries Railroad Company held their annual meeting and re-elected the entire board of directors. A resolution was passed to apply to the court to dissolve the corporation, as the road has been purchased by the city.

FRESNO, CAL.—Coupled with the announcement made by General Manager Webster of the Fresno Traction Company that six new center entrance electric cars would arrive in the city within a month was the statement that eventually the pay-as-you-enter system would be installed on all of the lines.

SAN FRANCISCO, CAL.—Engineers for the Crocker Estate Company are engaged in laying out an electric railroad tapping the holdings of the company in the South Hill district of San Francisco. The engineering work and a large percentage of the grading is practically completed. Approximately 1200 acres of the company's holdings will be made accessible for homesites with the inauguration of the line.

ALAMOGORDO, N. M.—In response to a communication from the Business Men's Association of Cloudcroft, asking for the support of the Commercial Club of Alamogordo in a movement towards securing the proposed electric line from Cloudcroft to Artesia, A. B. Carroll of St. Louis and associates are going over the proposed route securing the necessary statistics upon which to base a proposition for the construction of the line.

SAN JOSE, CAL.—The State Railroad Commission has extended the time in which the San Jose railroads shall reconstruct as a broad gauge line its present narrow gauge system from San Jose to King's Road, and then to Linda Vista, to connect with the line to Alum Rock. The company is given until August of this year to construct the standard gauge line from Twenty-sixth street to King's Road, and until February of next year to reconstruct its line from King's Road to Linda Vista.

SEATTLE, WASH.—The utilities committee of the council has recommended for passage a bill transferring $75,000 from the garbage fund to the city railway fund as a temporary loan. The amount will be used to pay for completing division "A" of the municipal street railway line. A bill transferring $23,500 from the general fund to the water fund to pay for water used by the city for October, November and December of last year, was recommended for passage. Both these bills now go to the finance committee for consideration.

TELEPHONE AND TELEGRAPH.

VENICE, CAL.—The Pacific Telephone & Telegraph Company has been granted a franchise in this city.

HILO, T. H.—Directors of the Hawaii Telephone Company have decided to spend $40,000 on improvements of the service on this island.

ELY, NEV.—A rural telephone system to connect all parts of the county with Ely is being agitated, and the residents are hoping to have work on the same start in the spring.

ALAMEDA, CAL.—After six months of deliberation, the public utilities committee of the city council has recommended that the Pacific Telephone & Telegraph Company be granted a franchise for 20 years.

OAKLAND, CAL.—Plans are being prepared for a 3-story and basement class A telephone exchange to cost $34,000 in Foothill boulevard west of Thirty-fifth avenue, for the Pacific Telephone & Telegraph Company by the department architect in San Francisco.

SANTA BARBARA, CAL.—The railroad commission has granted authority to the Home Telephone & Telegraph Company of Santa Barbara county to issue promissory notes in the sum of $15,000 and to pledge its bonds in the sum of $27,000 as collateral security therefor.

SAN DIEGO, CAL.—Lieutenant Commander G. C. Sweet, U. S. N., Washington, who has arrived in San Diego for the purpose of making an inspection of the Point Loma wireless station, states that work will probably begin within a month on the new $250,000 government station to be located near San Diego.

SEATTLE, WASH.—New long distance telephone toll rates have been put into effect by the Pacific Telephone & Telegraph Company, effective over all lines owned by this company. The new rates are based on the "air line" theory and will result in reductions in many cases and increased rates in others. Heretofore the long distance rates within the state have been based on a county system, with the result that in cases of towns a few miles apart but in different counties tolls have been unjust. It is the contention of the telephone company that under the new system of charges such injustices as this will be eliminated. In a letter of notification addressed to company managers in this state F. L. McNally, district commercial superintendent, states that more rates have been reduced than increased.

WATERWORKS.

ST. PAUL, ORE.—At a meeting of the city council a committee was appointed to investigate the advisability of putting in a plant to supply the city with water.

AZUSA, CAL.—The city council has instructed the city engineer to proceed with plans for calling a bond election; total, $50,000 to be voted on; $30,000 for water and $20,000 for light improvements.

ALPHABETICAL INDEX TO ADVERTISERS

The letter and number before each name are used in the classified page opposite

A-1 American Ever-Ready Co.
Los Angeles; 755 Folsom Street, San Francisco; Seattle.

B-1 Benjamin Electric Manufacturing Co.
Rialto Building, San Francisco.

B-2 Berkeley Electric Cooker Co.
1932 Center Street, Berkeley.

B-3 Blake Signal and Manufacturing Co.
680 Howard Street, San Francisco.

B-5 Bridgeport Brass Co. 4
(See Pierson, Roeding & Co.)

C-1 Century Electric Co. 3
614 So. Grand Ave., Los Angeles; Salt Lake City; 56 Natoma Street, San Francisco; Seattle; Spokane.

C-2 Crocker-Wheeler Co. 13
Title Insurance Bldg., Los Angeles; Salt Lake City; First National Bank Bldg., San Francisco; Seattle.

C-3 Cutler-Hammer Manufacturing Co. 15
579 Howard Street, San Francisco.

D-1 D. & W. Fuse Co.
(All Jobbers.)

D-2 Dearborn Drug and Chemical Works 13
355 East Second Street, Los Angeles; 301 Front Street, San Francisco.

E-1 Edison Lamp Works of General Electric Co. 11
(See General Electric Company.)

E-2 Edison Storage Battery Supply Co. 3
441 Golden Gate Avenue, San Francisco.

E-3 Electric Agencies Co.
247 Minna Street, San Francisco.

E-4 Electric Storage Battery Co.
Pacific Electric Building, Los Angeles; Spalding Building, Portland; 118 New Montgomery Street, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

F-1 Fairbanks, Morse & Co.
Los Angeles; Portland; 651 Mission Street, San Francisco; Seattle; Spokane.

F-2 Fort Wayne Electric Works of G. E. Co.
Rialto Building, San Francisco; Colman Building, Seattle.

G-1 General Electric Co. 14
124 W. Fourth Street, Los Angeles; Worcester Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Paulsen Building, Spokane.

H-1 Habirshaw Wire Co.
(See Western Electric Company.)

H-2 Hemingray Glass Co. 13
330 So. L. A. Street, Los Angeles; 345 Oak Street, Portland; 807 Mission Street, San Francisco.

H-3 Hoagland-Hulse Electric Co.
1707 Naud Street, Los Angeles.

H-4 Hunt, Mirk & Co.
141 Second Street, San Francisco.

I-1 Indiana Rubber and Insulated Wire Co. 16
807 Mission Street, San Francisco.

K-1 Kellogg Switchboard and Supply Co. 4
Aronson Building, San Francisco.

K-2 Keystone Boiler Works.
201 Folsom Street, San Francisco

K-3 Klein & Sons, Mathias. 16
579 Howard Street, San Francisco.

K-4 K-P-F Electric Co.
37 Stevenson Street, San Francisco.

L-1 Leahy Manufacturing Co. 13
Eighth and Alameda Streets, Los Angeles.

L-2 Locke Insulator Manufacturing Co. 5
(See Pierson, Roeding & Co.)

M-1 Mannesmannrohren-Werke
Rialto Building, San Francisco.

M-2 McGlauflin Manufacturing Co. 13
Sunnyvale.

M-3 Moore & Co., Charles C.
Van Nuys Building, Los Angeles; Spalding Building, Portland; Kearns Building, Salt Lake City; 40 First Street, San Francisco; Mutual Life Building, Seattle; Santa Rita Hotel Building, Tucson.

N-1 Nason & Co., R. N.
151 Potrero Avenue, San Francisco.

N-2 National Conduit & Cable Co., The
Trust and Savings Building, Los Angeles; Rialto Building, San Francisco.

N-3 National Lamp Works of G. E. Co.
(All Jobbers.)

N-4 New York Insulated Wire Co.
629 Howard Street, San Francisco.

N-5 Norris Co., L. A. 5
Monadnock Building, San Francisco.

O-1 Okonite Co. 16
(All Jobbers.)

P-1 Pacific Electric Manufacturing Co.
80 Tehama Street, San Francisco.

P-2 Pacific States Electric Co. 2
526 So. L. A. Street, Los Angeles; 90 Seventh Street, Portland; 526 Thirteenth Street, Oakland; 575 Mission Street, San Francisco; 307 First Ave., So., Seattle.

P-3 Parker Boiler Co.
201 Folsom Street, San Francisco.

P-4 Pelton Water Wheel Co. 13
2219 Harrison Street, San Francisco.

P-5 Pierson, Roeding & Co. 3
Pacific Electric Building, Los Angeles; Spalding Building, Portland; Rialto Building, San Francisco; Colman Building, Seattle; Pacific Building, Vancouver.

P-6 Pittsburg High Voltage Insulator Co., The 16
120 So. L. A. Street, Los Angeles; 343 Oak Street, Portland; 247 Minna Street, San Francisco; 560 First Avenue, Seattle.

P-7 Pittsburg Piping & Equipment Co. 16
Monadnock Building, San Francisco.

S-1 Schaw-Batcher Company, Pipe Works, The
211 J Street, Sacramento; 356 Market Street, San Francisco.

S-2 Simonds Machinery Co.
12 Natoma Street, San Francisco.

S-3 Simplex Electric Heating Co. 5
612 Howard Street, San Francisco.

S-4 Southern Pacific Co. 13
Flood Building, San Francisco.

S-5 Sprague Electric Works of G. E. Co. 4
Rialto Building, San Francisco; Colman Building, Seattle.

S-6 Standard Underground Cable Co. 16
Union Trust Building, Los Angeles; First National Bank Building, San Francisco.

S-7 Staples & Pfeiffer.
102 Steuart Street, San Francisco.

T-1 Thomas & Co., R.
(See Western Electric Co.)

V-1 Van Emon Elevator Co.
56 Natoma Street, San Francisco.

W-1 Wagner Electric Manufacturing Co. 13
Rialto Building, San Francisco.

W-2 Western Electric Co.
119 East Seventh Street, Los Angeles; 507 Sixteenth Street, Oakland; 680 Folsom Street, San Francisco; 1518 First Avenue, So., Seattle.

W-3 Westinghouse-Church-Kerr Co.
Pacific Electric Building, Los Angeles; Pacific Building, San Francisco.

W-4 Westinghouse Electric and Manufacturing Co. 6
Lewisohn Building, Butte; Van Nuys Building, Los Angeles; Couch Building, Portland; 212 So. W. Temple, Salt Lake City; 165 Second Street, San Francisco; Central Building, Seattle; Paulsen Building, Spokane.

W-5 Westinghouse Machine Co.
141 Second Street, San Francisco.

W-6 Westinghouse Lamp Co.
(See Westinghouse Electric and Manufacturing Co.)

W-7 Weston Electrical Instrument Co. 3
682 Mission Street, San Francisco.

W-8 Western Pipe & Steel Co.
1758 North Broadway, Los Angeles; 444 Market Street, San Francisco.